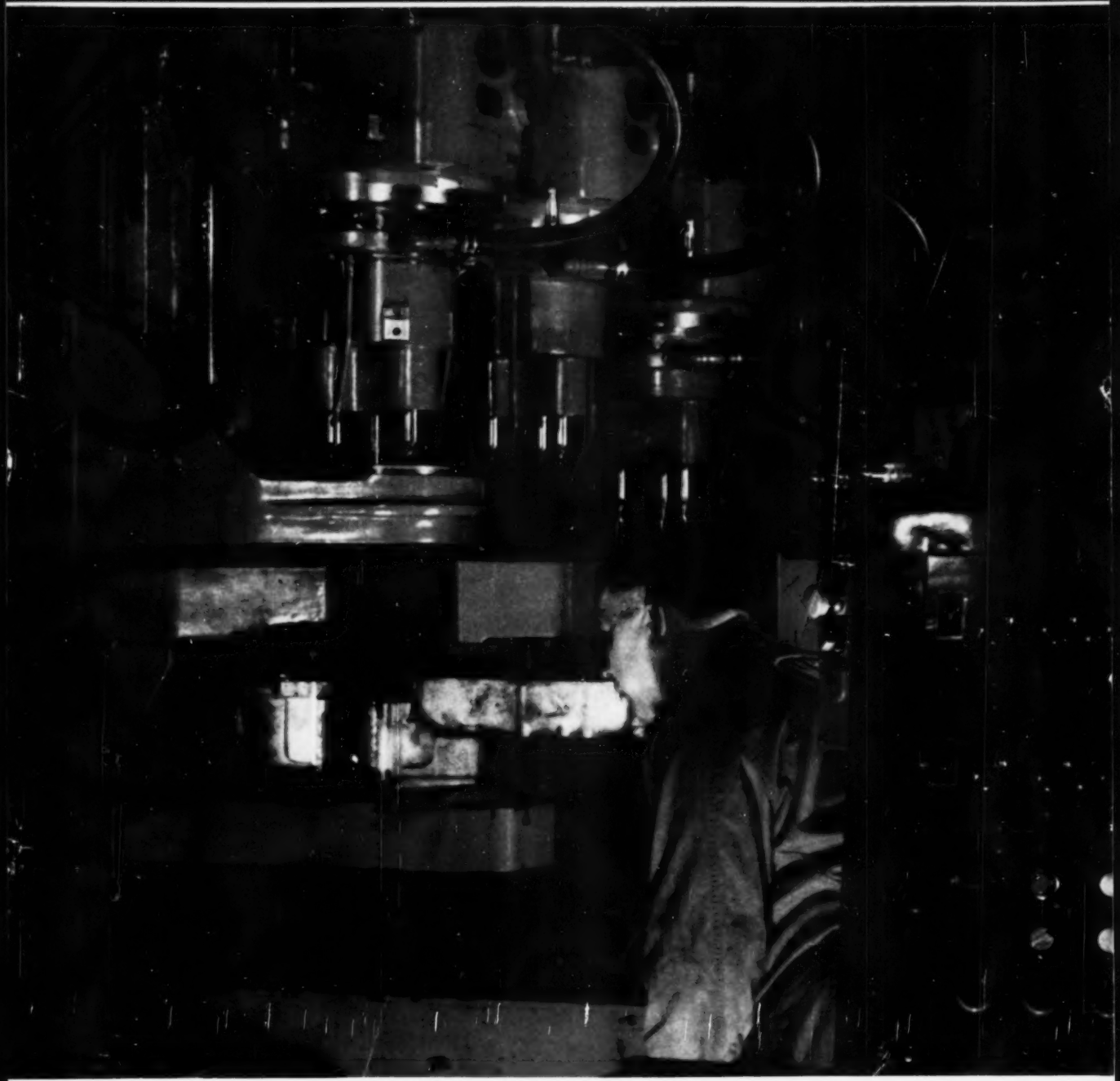
American Machinist

AUGUST 10, 1959 75¢

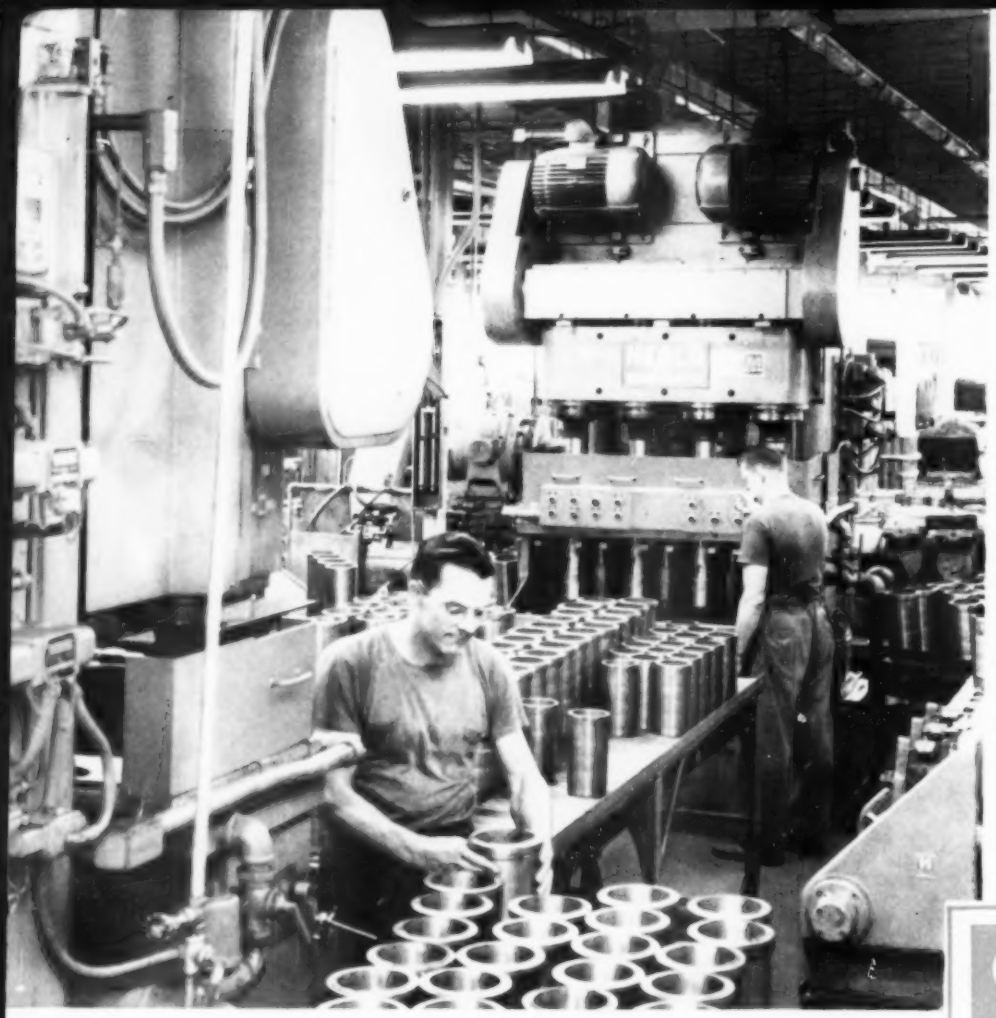
McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

Measuring Nonferrous Surface Finish

a Special Report, page 105



Numerical control saves tooling, gives diesel builder flexibility—see page 96



Two Heald Model S Bore-Matics installed in diesel engine plant for rough and finish boring cast iron cylinder liners. Unit in foreground performs the roughing operation, with capacity of up to 1/4" of stock removal on four parts at a time, followed by finish boring on identical machine at the right.

HEALD

KING-SIZE BORE-MATICS

rough and finish bore diesel cylinder liners FOUR AT A TIME

HEAVY-DUTY roughing and precision finish boring are the dual functions of the two Heald Model S Bore-Matics shown above. Installed in a large diesel engine plant, these huge, 40,000-pound machines are identical except for tooling — each handling four large cast iron cylinder liners at a time.

One machine, used for the roughing operation, is capable of removing a full quarter inch of stock — the other is used for finish boring to close tolerances for size and concentricity. Each four-station machine is equipped with a hydraulic clamping fixture and operates on a fully automatic push-button-controlled cycle. Total cycle time is 266 seconds on the roughing operation, with a net production of approximately 40 parts per hour.

These big vertical Bore-Matics are further evidence of Heald's ability to handle all phases of a machining operation from rough casting to finished part on any size work.

It PAYS to come to Heald

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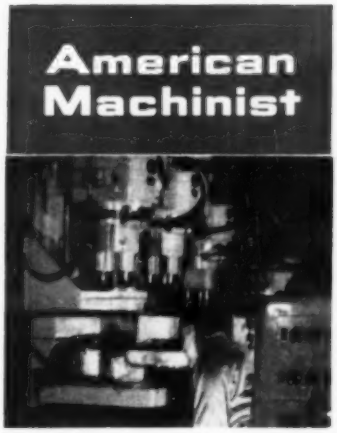
METALWORKING REPORT

SIGNIFICANT CURRENT DEVELOPMENTS IN TOOLING AND PRODUCTION PROCESSES



COVER:
First numerical-tape-control system on a production line in the automotive industry is at Detroit Diesel, where a Natco triple-head multiple-spindle drilling machine is operating. Control is by punched tape that is programmed with data taken directly from part drawings —a 15-minute operation. The parts are all flywheel housings in up to 80 different shapes and hole arrangements. All are mounted on the same universal work fixture that indexes under the three heads through two-axis control. See p96.

CUTTING

Ultrasonic, Spark Combined

Electric - discharge machining has been combined with ultrasonic machining by Federici of Milan, Italy. While spark erosion breaks out tiny particles of parent metal, the high-frequency vibrations contribute to rapid chip removal. The system is therefore faster than either machining method alone, and it is said to be highly accurate. The "Ultraelectric" machine synchronizes spark and ultrasonic vibrations so the tool is moved toward and away from the work each time a spark is generated. Any metal can be cut, as well as many non-metals, such as glass. Special devices included in the machine keep the rate of tool wear much lower than the rate of workpiece wear. Adjustment of the distance between work and tool is critical, but is controlled by an electronic servo. The equipment has a stroke limiter that turns off the machine after predetermined travel, and has a circuit that prevents short-circuiting. The machine has been available in Italy, where about 100 units have been operating; but is not yet ready for import into the US.

FORMING

Vacuum-Assisted Die Casting

Better quality in die castings, with high density, smooth "hardware" finish ideal for plating, and sections now impossible to produce, is the claim for vacuum die casting. About four systems are now available:

- Basic system is called Nelmor, adopted about three years ago by Reed-Prentice for zinc. System was expensive, requiring entire die area to be shrouded—and vacum of only 18 in. of mercury could be drawn.
- American Die Casting Institute has developed and applied for a patent on a new method that is aimed at lower costs. However, details are not yet available to non-members.
- Morton system for zinc or aluminum has been taken up by Cleveland Automatic Machine Co, and is now available with machines rated up to 1000 tons. Both the die and ladle can be evacuated with aluminum. Vacuum of 28 in. can be drawn on die area only. Cost to equip a 400-ton machine is only around $3600.
- Castmaster and Hydraulic Press Divisions of Koehring Corp have also adopted the Morton system. A somewhat different idea is being developed by B & T Machine division of Greenlee Bros.
- Kux Machine now has some machines in customer plants. Systems are offered for plunger gooseneck models for zinc and cold-chamber machines for aluminum and magnesium. No enclosing hoods are rerequired for the zinc machines; and only slight die modification. As with Cleveland Automatic's equipment, only small vacuum pumps and accumulators are needed to achieve 28 in. of vacuum. Aluminum or magnesium can be hand ladled or drawn automatically by a "Vac-U-Die" system. Metal is drawn from a covered melting pot through a feed tube into an evacuated injection chamber that feeds the evacuated die.

Forged Nose Cones

Copper closed-die forgings more than 5 ft in diameter by 2 ft deep by $1\frac{1}{4}$ in. thick are now being produced for nose cones of the Atlas and Thor intercontinental ballistic missiles.

Eight months ago a forged-copper nose cone of this size was considered an impossibility. Billets up to 28 in. diameter are sawed to proper length, heated, then pancaked to 30-in. dia by 9 in. thick on an 18,000-ton closed-die forging press.

Now the part is transferred to the 50,000-ton hydraulic press, which uses a pair of dies weighing 70 tons.

HEAT TREATING

Nonflammable Quenching Bath

A water soluble chemical, whose quenching power can be controlled by varying the concentration, provides a nonflammable quenching bath that can be used in standard heat treating operations, flame hardening, and induction hardening. Manufactured under the name Hannite by the J Hannan Co, Cleveland, the material forms a near-perfect solution—there are no undesirable sludges or suspended matter, the solution is colorless, non-toxic, long-lasting and nonflammable.

DON'T FORGET . . .

Metalworking Report is not a synopsis of this issue of American Machinist. Major articles are described briefly in the Contents on the page preceding this one. Trends pages are classified by subject and information in them is not repeated elsewhere. Most of the developments in Metalworking Report are so new that further information is not yet available—when it is, you will find a page reference to the article.

Electrolytic Hardening

Steel is being case hardened in Russia by an electrolytic process that produces a high surface temperature. The material is treated cathodically in a 5-10% sodium carbonate solution at 60 C, using 4000 amps per sq ft at 200 volts. Obvious advantages include negligible distortion and uniform case depth; one drawback may be hydrogen embrittlement. Organic stop-offs can be used if selective hardening is required.

INSPECTION

Thread-Gage Wear Check

Wear on thread gages for hydraulic hardware can be read off directly after a minor modification is made to a Bausch & Lomb DR-25 optical gage. Aeroquip Corp, Jackson, Mich, ground off and lapped flat the original top moving gage spindle, then added a thread form to the lower anvil. This permits three-wire inspection of thread gages to quarter tenths, which allows checking wear. The system is faster than previous methods. If higher accuracy is required, this high speed for routine measurement permits extra time for special checking.

International Inch Again

The new international inch is 2 millionths shorter than the old U S inch (*AM*—Feb 23 '59, p89), but the question is when will this affect precision measurements? Pratt & Whitney Co, W Hartford, Conn, answers this question simply with two charts.

One chart shows length tolerances, which are significant when the difference between inch standards equals 5% of the working tolerance. On a dimension of 10.0 in., for example, the chart indicates that a tolerance of 0.0005 in. will not be affected by the 2-millionths difference, but a tolerance of 0.0003 in. *will* be affected. As lengths increase, the difference gains importance. On a length of 50 in., for example, a tolerance of 0.001 in. is well within the "significance" zone.

The temperature conversion chart gives corrections to make on steel parts, and also scales to find corrections for aluminum at various temperatures.

WELDING

Cuts Cost on Test Coupons

Titanium test coupons can cost big money if you need about a million and a half of them. Ryan Aeronautical Co expected to use that many

OUTLOOK:

Metalworking operations, at an all-time high, will gradually be curtailed as the steel strike lengthens. But indications are that any losses in the production rate will be wiped out shortly after full steel production is resumed. Fourth quarter looks bright.

for setting up spotwelders and maintaining quality welds on DC-8 pod access doors. But Ryan employees have found two ways to hold down the cost of this potentially expensive item.

One is a fairly standard technique—cutting the 4 x 1-in. shear test samples from sheet cutoffs that would otherwise be discarded.

The other, however, comes from the unique properties of titanium. Unlike aluminum and stainless steel, the titanium sample strips do not bend or stretch when the spotweld is pulled apart. The shear test machine does not even materially mark the grip end of the sample as it would on softer, more ductile materials.

Therefore, the sample strips can serve for as many as four or five tests. Expected savings: about 600,000 test coupons for the balance of the contract.

Disposable Backup Bars

Welding aluminum ballistic shells for the Redstone and Jupiter-C missiles, the Reynolds Metals Co plant at Sheffield, Ala, has developed a new backup bar that consists of an aluminum base supporting a T-shaped stainless steel insert. Thus, the stainless steel contributes durability, and the aluminum contributes heat conductivity.

When the grooves in the insert finally do become burned and pitted, it can easily be discarded and replaced—at about one-half the cost of repairing the all-stainless bars used previously. The aluminum aids the welding operation by conducting the heat away from the weld area much faster than the old-style bars did.

ASSEMBLY

Induction Desoldering

Printed-circuit assemblies and chassis boards can be desoldered and repaired about 20% faster than usual with an induction heater just announced by General Electric. The table-top console has an induction coil over which the work—and spot to be desoldered—are positioned. A small spotlight aimed at the coil from an overhanging arm helps locate the work. Heat is delivered to the coil by automatic or manually controlled cycle, followed by air blowoff that cools the work. Solder is added manually if a new component is to be added to the circuit. Old solder is removed from the work by a vacuum system built into the console.

FINISHING

Temperature-Regulating Coating

A heat-sensitive coating that changes color with temperature variations has been developed at Space Technology Laboratories, Los Angeles, Calif. Intended for use on space satellites, the coating automatically maintains uniform temperature inside the vehicle by becoming lighter in color as the internal temperature rises—thus reflecting heat and radiation. If the internal temperature falls, the coating becomes darker and absorbs more heat.

Some 35 different substances have been found to have this property, and the coating may vary from a paint-like substance to a plastic applied in several layers. Color changes may be quite startling; one material, for example, changes from red to yellow with increasing temperature. In the case of the polymer compounds, use is made of the reversible transition from the solid state to gel as temperature increases.

Temperature-sensitive paints to indicate the presence of heat are fairly common, but this is believed to be the first use of similar material as a control device. Potential applications, apart from satellites, may lie in the construction of homes, autos, and aircraft, and may include sun glasses with automatic light control, glass walls with built-in blinds, and even clothing for more comfortable living.

MATERIALS & COMPONENTS

Titanium Clad

Research at the Lukens Steel Corp has made possible the manufacture of titanium-clad steel. Use of the clad plate provides a chemical resistant material at a price below $3 per pound as compared with $8 or more

METALWORKING REPORT...

per pound for solid titanium plate. In addition, gages and plate sizes are available in the clad form which are not standard in solid Ti plate. Largest plate size practical at this writing, containing a 20% clad, is 135 in. long by 49½ in. wide by 15/16 in. thick.

Normally cores are low-chromium, low-molybdenum alloy. Materials such as ASTM A-202, A-204, A-387B, and A-387C have been used. As hot-formed into vessel heads, the titanium clad steel tested out with an average shear strength of 27,000 psi. Tests of different heads using various alloy bases showed shear strength ranging from 23,500 psi to 44,800 psi. It is expected that the availability of titanium in this form, together with the lower cost, will markedly improve the market for this metal.

Electro-Process Plastics

When polystyrene gets the "hot seat" it comes out stronger, according to reports on experiments at Armour Foundation, Chicago. Processing a commercial plastic such as polystyrene in an electrical field at the same time it is subjected to external heating increases the tensile strength approximately 25%.

Evidence so far has prompted ARF electrical engineers to look further into improving material characteristics of plastics such as polyethylene and vinylidene chloride, as well as polystyrene. It is possible that the passage of electrical current has an effect similar to radiation in creating better molecular alignment or longer molecular chains.

Controlling Tinplate

Called Data Accumulation for Electrolytic Tinning Lines, a new system that automatically accumulates, records and prints deviations in the quality of tinplate coils has been developed by Airborne Instruments Laboratory, Mineola, NY. One of the systems has been sold to Inland Steel Co. One value of the system is that the customer is assured of quality tinplate by the printed record—a printed ticket and a perforated paper tape.

MANUFACTURING CONTROL

Infra-Red Heating

Provide heat only where it's needed —that's the idea behind infra-red heating units. By heating only the areas where men are working, rather than the whole plant, these units can provide worker comfort at savings over conventional heating equipment. Suspended overhead, they give direct heat that warms workers, machines, and floors—even with constant air movement.

Infra-red heating is nothing new, but its application to production lines in Metalworking has up to now not been commonplace. One of the largest installations recently (at Bethlehem Fabricators, Inc, Bethlehem, Pa) involves the use of 290 gas-operated infra-red units to heat seven buildings. (*AM*—Jun 1 '59, p97.)

A new system at the Louisville, Ky, plant of Junkin Safety Appliance Co is typical of what might be expected along a production line. Seven heating units are suspended in a line, radiating over a 25 x 85-ft area. Units are rated at 168,000 BTUH, sufficient to maintain a thermostat temperature of 70 F until outside temperature goes a few degrees below freezing. Cost of operating the units on propane is $2.80 per 8-hr day; using line gas brings the cost down to $1.51 for the same period. These heaters, made by Perfection Industries Div of Hupp Corp, require no morning warm-up period; workers benefit immediately.

Paging by Radio

A system recently developed in Holland, the Nira Tele-tracer offers a simple, relatively inexpensive way to locate key personnel scattered throughout a busy plant. Each person carries a receiver tuned to a given frequency that indicates, by an intermittent buzzing signal, when he is wanted. He then goes to the nearest telephone to take the message.

The receiver is a lightweight unit —no bigger than a cigarette package—that is clipped to the belt or carried in the breast pocket. Powered by an accumulator (not a battery), it contains four transistors that activate the buzzer.

The transmission system is equally simple: The main control unit incorporates a signal transmitter and amplifier, and the transmitting antenna is a single loop of insulated copper wire that surrounds the area.

Equipment is made in three sizes for paging up to 9, 45, and 360 persons, and can cover an area up to 500,000 sq ft.

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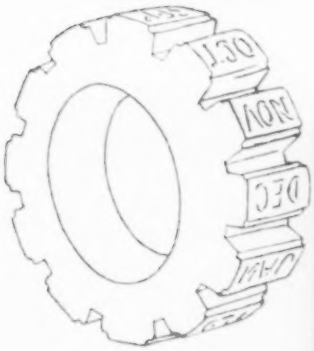
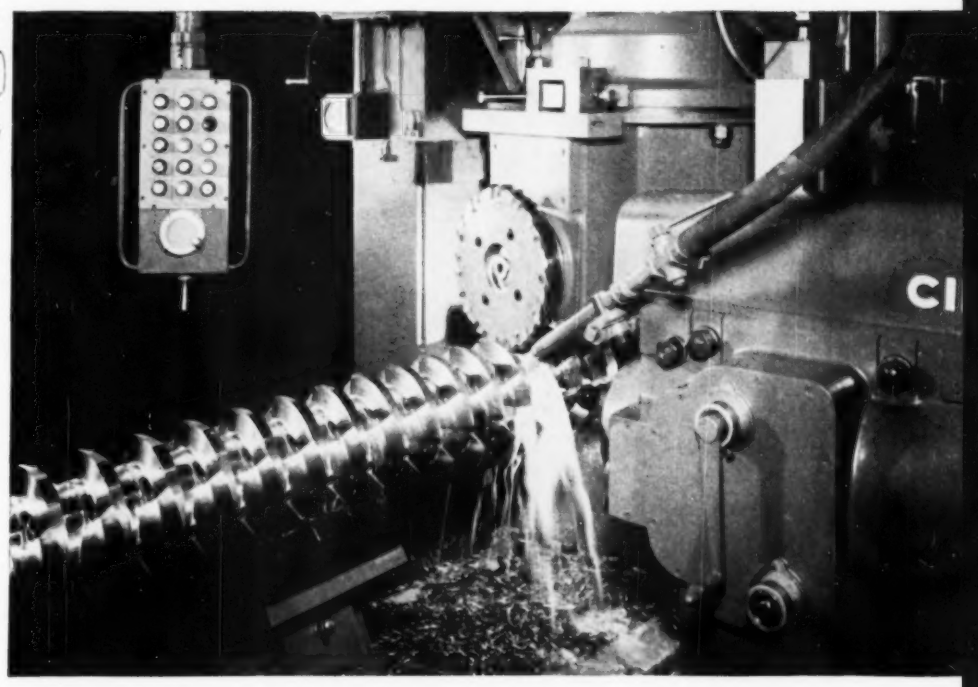
Month Wheels and Mixing Screws...





Milling the helix on long mixing screws. These parts are machined faster and better than ever before, on a CINCINNATI Special Milling Machine designed specifically for the job.

(Photograph courtesy of Baker Perkins, Inc., Saginaw, Mich.)

Machines for producing them at the lowest cost are built by

CINCINNATI | SPECIAL MACHINE DIVISION

Mixing screws operate in chemical and food machinery. Month wheels are an integral part of several types of accounting equipment. Machines for performing the critical operations required to produce these parts... milling the helix and rolling the letters... are typical of the unusual types of equipment built by the Cincinnati Special Machine Division.

Engineering specialists in this Division tackle almost any machinery problem for any industry. These men have the support of the most extensive research, foundry and shop facilities in the machine tool industry, plus the experience of all those who preceded them during the past 45 years in designing and building special machines. And you will be pleased with Cincinnati's follow-up service to assure dependability of performance. Take a look at the examples on the next two pages, then call the Special Machine Division to help you with your unusual problems. **Special Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

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BROACHING MACHINES • COMPLETE PRODUCTION LINES

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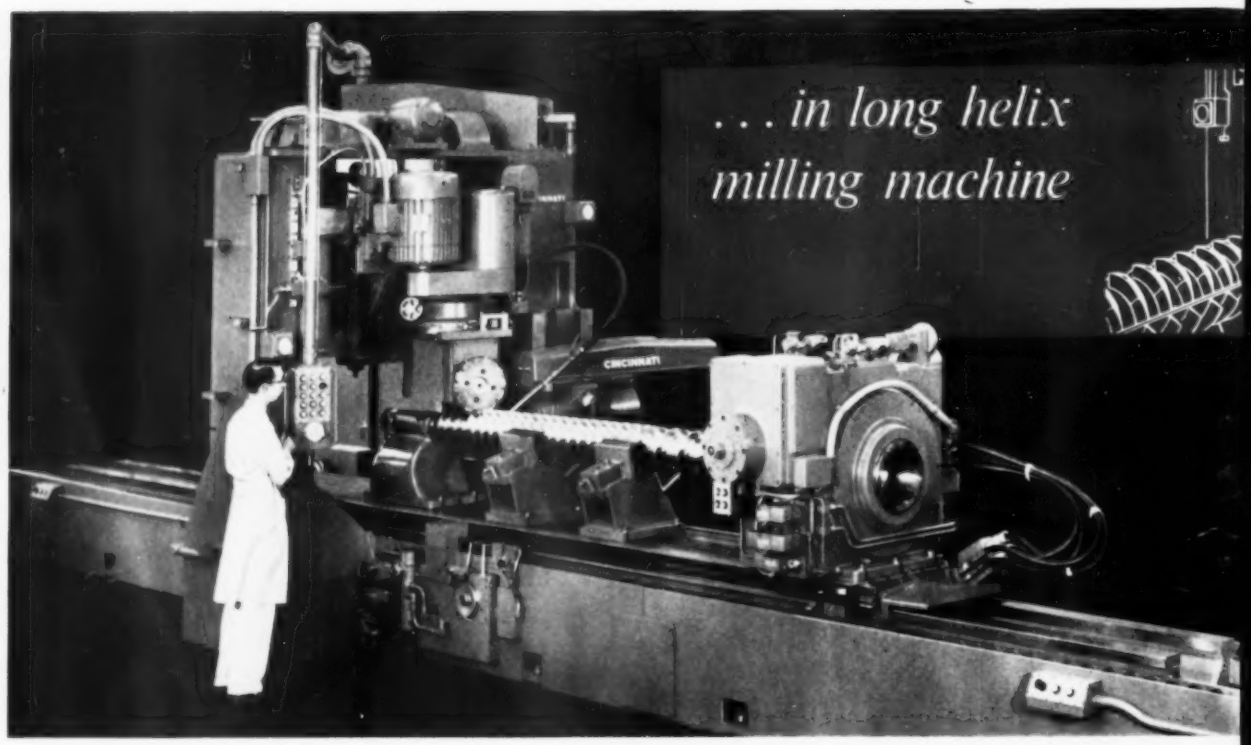

Deep helix mixing screws, requiring four types of operations, are milled on this CINCINNATI Special Helix Milling Machine. It has the capacity to handle any size screw from 4" to 24" diameter, up to 24 feet long.

(Photo courtesy of Baker Perkins Inc., Saginaw, Mich.)

The helix on screws can perform many useful and diverse operations. It mixes chemicals, flour and other products in industries handling bulk materials. Milling the helix in a family of large screws for this type of equipment proved to be too expensive for one machinery builder, so he enlisted the aid of Cincinnati Milling's Special Machine Division. Their specialists developed a machine having a conventional horizontal spindle (standard HyPowermatic unit) and a heavy duty 20 hp universal spindle head. The helix is roughed out by the large cutter above the part, and finished with the end mill in the conventional horizontal spindle. Cincinnati's unique Telephase control system operates the fixture rotation in exact relation to table travel, producing an unusual combination of highly accurate right- and left-hand leads.

Many smaller units of production equipment, just as effective in reduc-

DESIGNERS AND BUILDERS OF SPECIAL MACHINES • VERTICAL AND HORIZONTAL BROACHING

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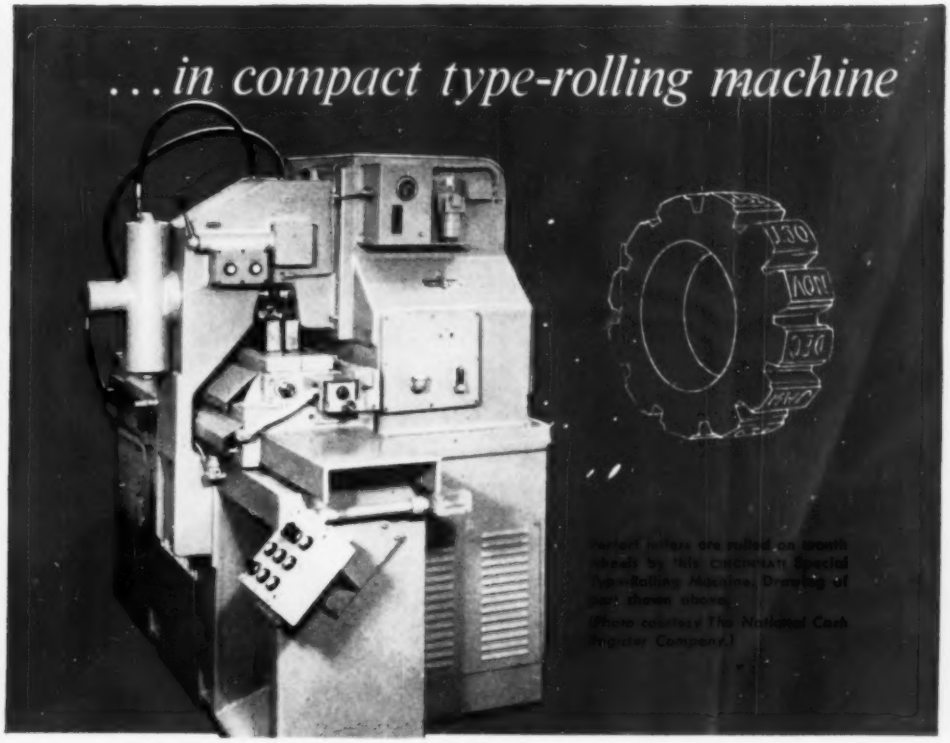

ing costs but lacking the glamour of big machines, also are designed and built by the Special Machine Division. The Automatic Type-Rolling Machine shown here is an example. It rolls month abbreviations, AUG., SEPT., etc., in the lands on month wheels. Pushing a button clamps the work; air jets keep the operation clean. Impressions are rolled 1/32" deep in 17 feed and 13 finishing passes, in a 55-second cycle.

Giant production lines; big machines having a high degree of "intelligence"; compact, single cycle machines... all are built by Cincinnati and are dependably operating in various plants, producing at the lowest possible cost. Our Field Engineers will be glad to show you what the Special Machine Division has done, and give you an analysis of what they can do for you.

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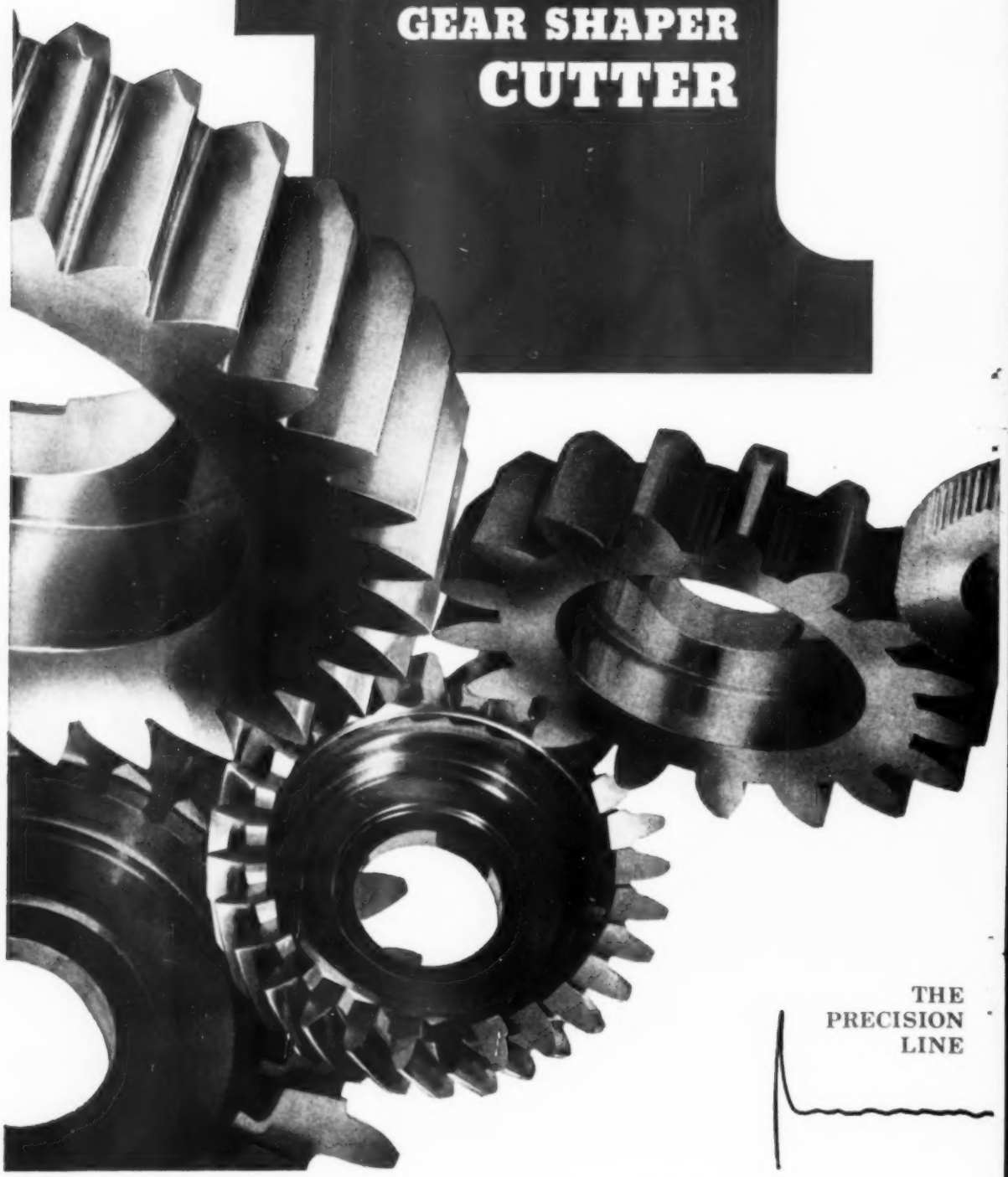

THE PRECISION LINE

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The Fellows Cutters you order today have unequalled experience behind their manufacture: the first gear shaper cutter ever made was designed, produced and patented by Fellows in 1897. Hundreds of thousands of Fellows Cutters have been made and used on gear production lines since that time.

This vast experience has resulted in constant progress, year after year, in cutter design and manufacture. Today, new gear and cutter designs are checked on a high-speed electronic computer which permits complete mathematical study of all possibilities. Constant advances in metallurgy and in manufacturing methods assure outstanding cutter performance on every gear production job.

A booklet, "Fellows Gear Shaper Cutters", covers the subject in detail. It includes tables of stock cutters, design considerations, sharpening methods, and other information. For a copy, contact any Fellows office.

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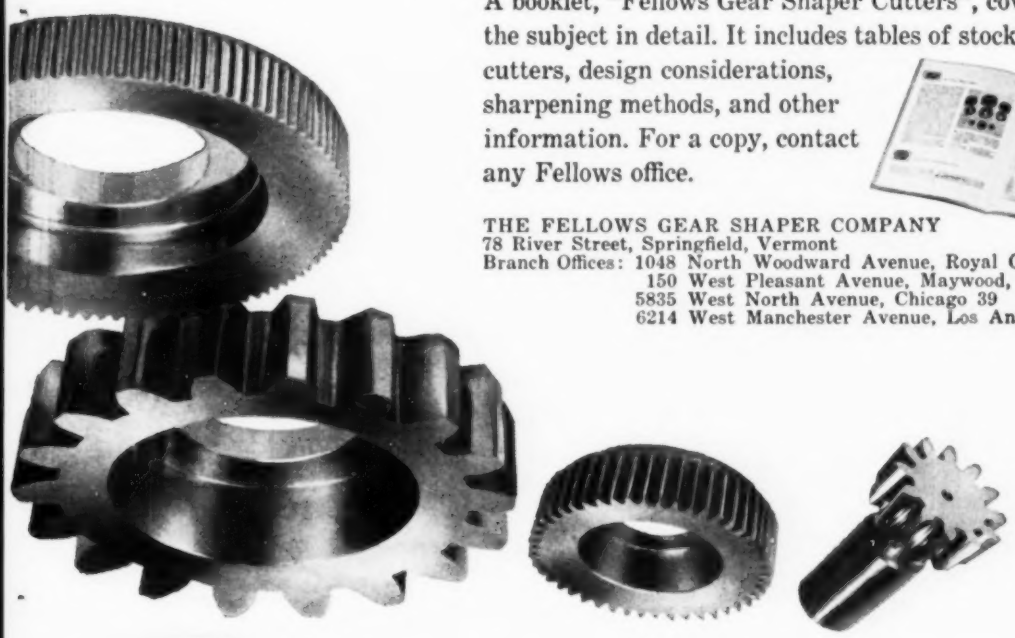
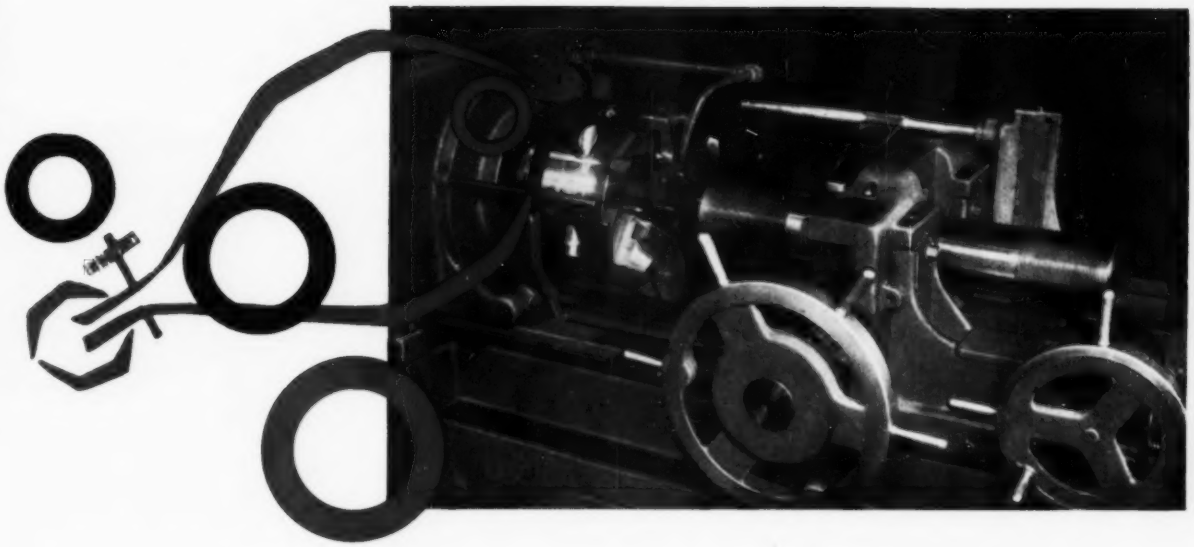


Fellows *Gear Production Equipment*

heavy duty machine

....precision threading

of large diameters



The cutting of large diameter threads to .003" tolerance at the Kilbourn Engineering Co., Milwaukee, Wisconsin is an example of the heavy duty threading possible with the 48C LANDMACO Machine.

4140 steel heat-treated to 280-320 Brinnel is used in the production of 33½" long double end studs used in high pressure vessels. 5¼" 8 pitch U.N. threads are cut on both ends at 15-20 SFM by a 6" 48C Single Spindle LANDMACO Machine equipped with lead screw feed, automatic workstop, and a six-chaser 48R LANCO Heat Treated Die Head. The stud end has an 8" thread length threaded to a pitch diameter tolerance of .003". The nut end has a 6" thread length threaded to a Class 2 fit.

This operation is an example of the ease with which LANDIS equipment can solve your most difficult threading problem. The heavy duty construction of both the machine and the die head plus the lead screw feed ensures threading to precision tolerances.

Futhermore, the LANDMACO Machine is equipped with hammer blow handwheel carriage fronts as standard equipment. This reduces operator fatigue, always a consideration when producing heavy, large diameter workpieces. Automatic work stops (as used in this operation) are available as auxiliary equipment to position the work for correct thread length and reduce pre-threading handling time. Available in double or single spindle models their ranges are: 2½" to 6⅝" bolt, and 2½" to 6" pipe. For more information ask for Bulletin H-45-2.

Perhaps there are threading operations in your plant that could be achieved at lower cost, with better quality thread, or greater versatility of production. LANDIS has had over 50 years' experience solving every type of threading problem. May we help with yours?

LANDIS *Machine* COMPANY

WAYNESBORO · PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

506C

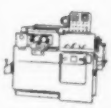
Threading Machines

Die Heads—Rotary & Stationary

Taps—Collapsible & Solid Adjustable

Centerless Thread Grinding Machines

Thread Rolling Tools


Thread Rolling Machines

LANDIS micro

feed

gives uniform size, roundness and finish for *more* usable work pieces

MICROFEED is the new Landis precision wheel feed for large or small lot *production* grinding. On a new Landis grinder you can have this development that assures grinding precision to your closest tolerances. MICROFEED is an extra fine feed to final size that automatically cancels machine temperature variations, wheel wear, wheel pressure changes, and work variations.

Operation of MICROFEED is not complicated. It saves setup time, raises output by eliminating scrap due to feed variations.

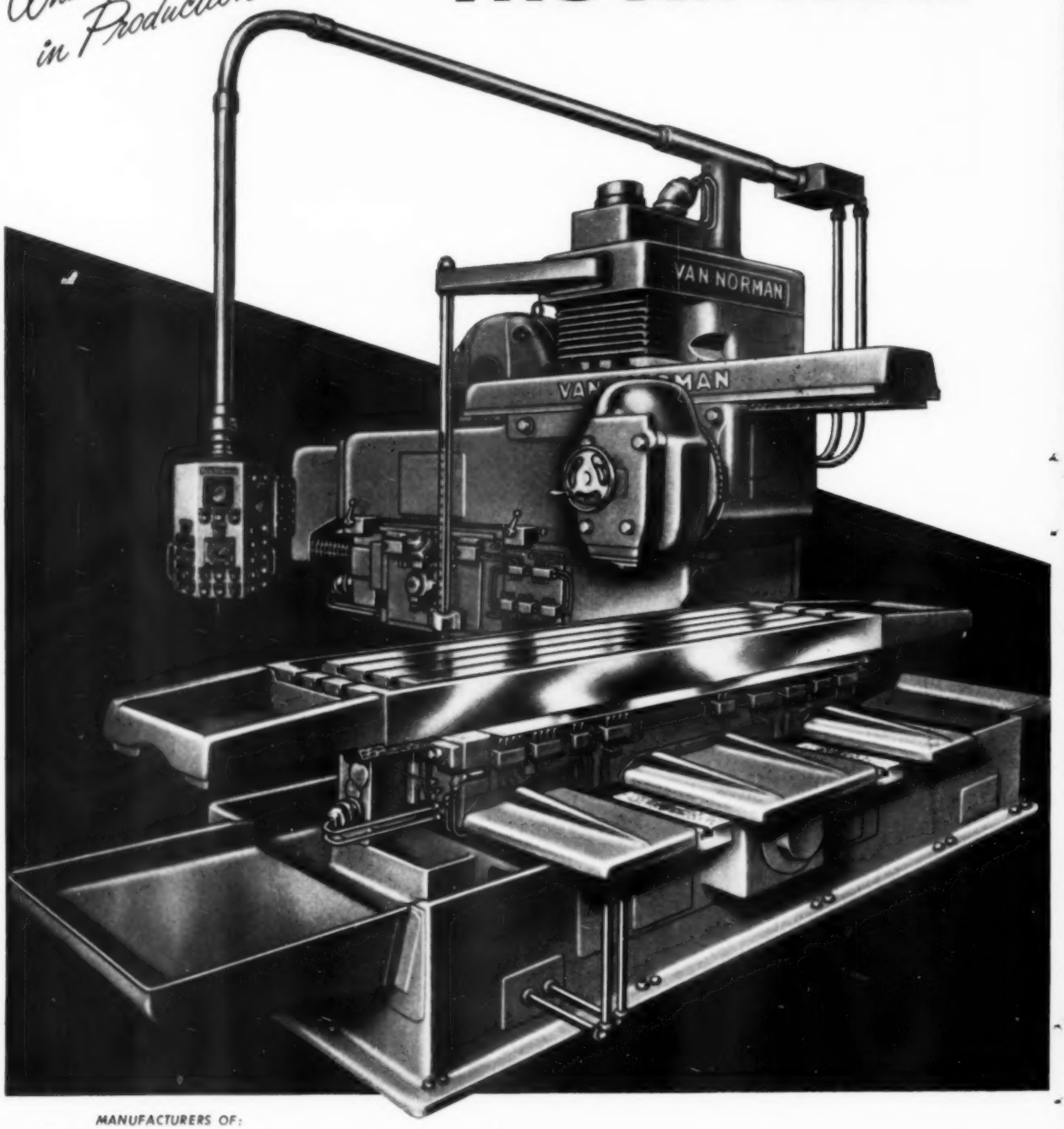
LANDIS

precision grinders

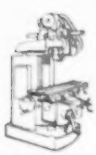
LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

What's New Newest in Production Millers?

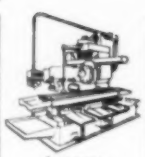
The All-New

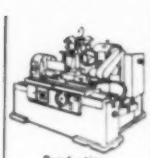


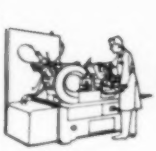
MANUFACTURERS OF:


Milling Machines

Standard Cylindrical Grinders


Bed-type Mills


Production Grinders


Centerless Grinders

VAN NORMAN

SPRINGFIELD 7, MASSACHUSETTS

Van Norman 746

VERSI-MATIC

- **Designed and built for modern production**
- **Engineered for numerical control**
- **Offers maximum rigidity — accuracy — versatility — range — horsepower**
- **An 18-ton precision-built bed-type miller**
- **Also available without saddle**

Here it is — the newest thing in production millers — just the machine to cut or shape all of the new, tough super alloys while still maintaining exacting tolerances. *And* the 746 retains all the famous Van Norman quality features including the exclusive Van Norman 4-way cutterhead.

Examine closely the detailed specs of this newest Van Norman production miller. Then contact your nearest Van Norman dealer or write directly to Springfield.

We'll be glad to show you how the 746 Versi-Matic can fit into *your* production line.

SPECIFICATIONS

NO. 746 VERSI-MATIC VAN NORMAN SADDLE BED TYPE MILLING MACHINE
NO. 796 VAN NORMAN BED TYPE MILLING MACHINES

		746 with Saddle	A.I.A.* Med. Size	796 without Saddle
TABLE SIZE	Length	96"	94"	108" also 130"
	Width	24"	20"	30"
	T-Slots (3)	1 1/16"	1 3/16"	1 1/16"
POWER FEED TRAVEL	Longitudinal	50"	50"	72" also 108"
	Transverse (Saddle)	14"	14"	–
	Transverse (Ram)	44"	–	44"
	Vertical	35"	20"	48"
CLEARANCE MAX.	Spindle to Table (Horiz.)	35"	20"	48"
	Spindle to Table (Vert.)	22"	–	35"
	Cutter Dia.	16"	16"	16"
POWER FEEDS IPM	Longitudinal (Table)	1/8-90	1/8-90	1/8-90
	Transverse (Saddle)	1/8-90	1/8-90	1/8-90
	Transverse (Ram)	1/16-45	–	1/16-45
	Vertical	1/16-45	1/16-45	1/16-45
	No. Steps	Inf.	32	Inf.
	Rapid Traverse (Table & Saddle)	150	150	150 (table only)
	Rapid Traverse (Vert. & Ram)	75	–	75
SPINDLE	Horsepower	25 50	25 50	25 50
	R.P.M.	15-1500	15-1500	15-1500
	No. Steps	18	16	18
	Head Swivels	120° (30° by vert.)	–	120° (30° by vert.)
	Taper	ASA 50	ASA 50	ASA 50
	Flange	ASA 60	ASA 60	ASA 60
WEIGHT	Net approximately	37,000 lbs.	–	41,000 lbs.

*Aircraft Industries Association NAS-909 Specifications.

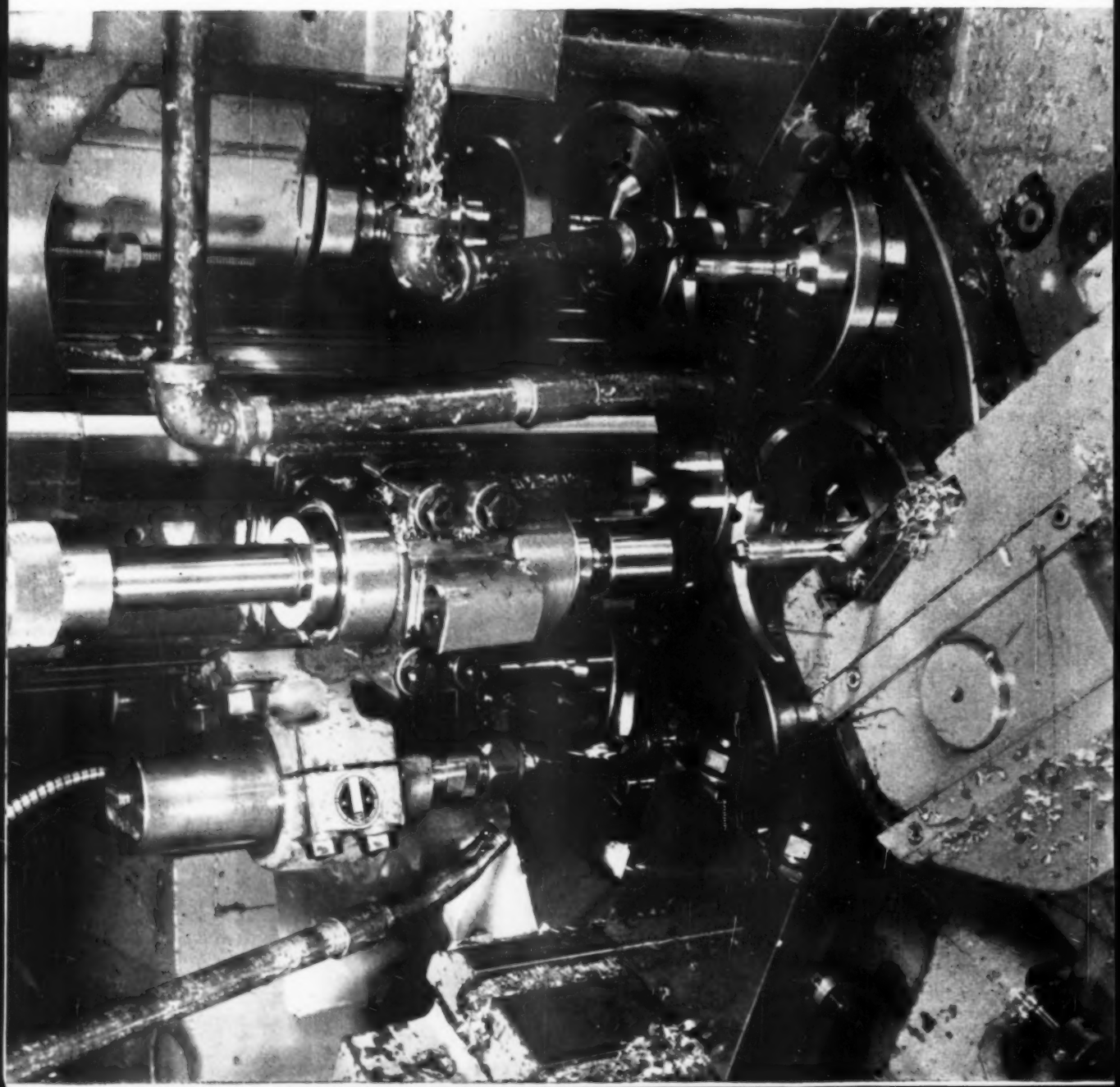
Don't wait . . . for extra profit install a Van Norman machine now! They are available in many purchase plans . . . Outright sale . . . Purchase on conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

MACHINE COMPANY

A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

CIRCLE 164 READER SERVICE CARD

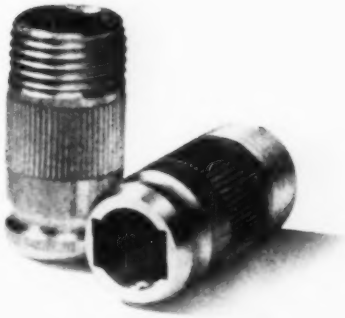
At Porter-Cable Machine Company.....



6-Spindle Automatic

saves $12,700 on this one job!

A savings of over 7½¢ was realized on each of these small brass Brush Holder Bodies for electric motors when this formerly subcontracted work was handled on one of their 1¼" Warner & Swaseys.



Porter-Cable of Syracuse, N. Y., veteran producer of wood-working tools and powered garden equipment, reports through their Chief Manufacturing Engineer, Charles Allen:

"Our two Warner & Swasey 6-Spindle quick setup Automatics have an important place in our cost-reduction program. They consistently turn out the highly accurate parts our products require, saving us money on jobs that run in lot sizes from a few hundred to many thousand pieces."

Here's what Warner & Swasey 6-Spindle Automatics did for Porter-Cable Company:

- **ACCURACY**— Tolerances of plus or minus .001" easily held, maintaining high product quality.
- **SAVINGS**— Second operations were eliminated — handled complex work formerly subcontracted.
- **FAST SETUP — SMALL LOTS**— Jobs previously run on hand screw machines now more efficiently handled on the Automatics.
- **VERSATILITY**— Machining of tougher materials, parts with threads at each end, multiple diameters, broached holes are all now routine operations.

Why not have our Field Engineers evaluate your operations with a view to highlighting jobs that could be more profitably machined on modern Warner & Swasey Multi-Spindle Automatics? He's as near as your phone — call him today!

The rugged Speedmatic Belt Sander—only one of Porter-Cable's quality products.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

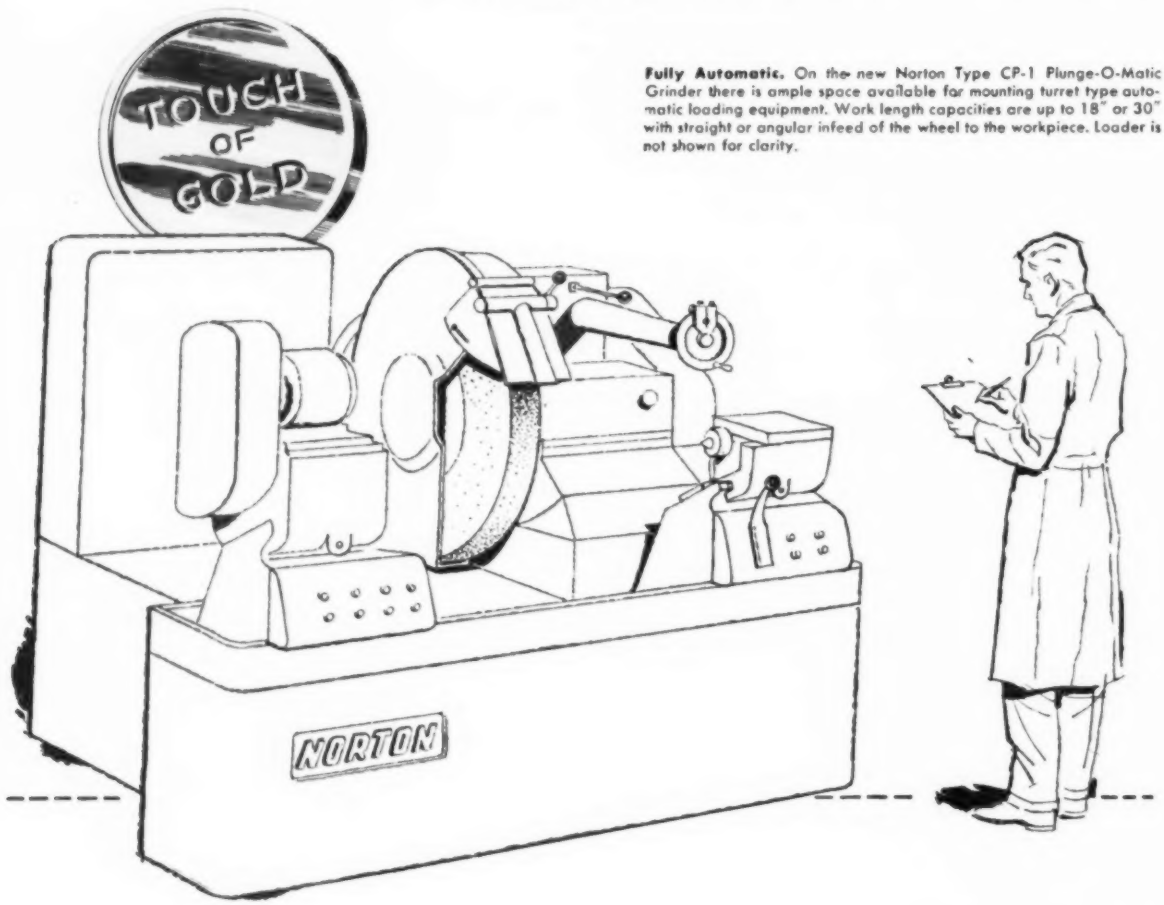
You can produce it better, faster, for less . . . with a Warner & Swasey

◄ CIRCLE 165 READER SERVICE CARD

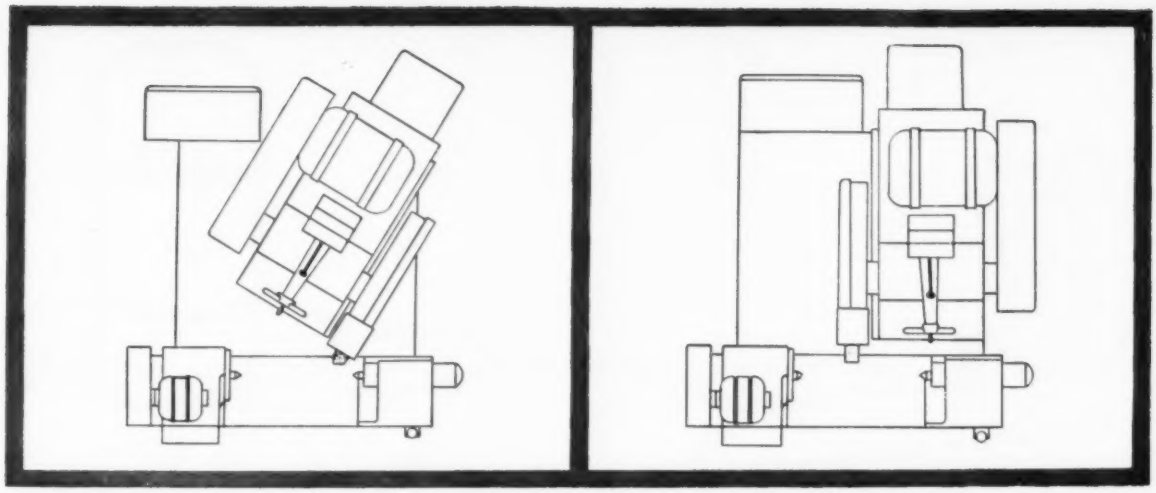
CIRCLE 166 READER SERVICE CARD

Built for one big purpose!

New Norton Plunge-O-Matic* Grinder simplifies



Fully Automatic. On the new Norton Type CP-1 Plunge-O-Matic Grinder there is ample space available for mounting turret type automatic loading equipment. Work length capacities are up to 18" or 30" with straight or angular infeed of the wheel to the workpiece. Loader is not shown for clarity.



Versatility of design allows positioning the wheelhead as required for the job. Those shown are only two of many possible variations.

automatic loading for mass production grinding

In design, the Norton Type CP-1 Plunge-O-Matic Grinder is brand new. While retaining outstanding proven features of Norton cylindrical grinders — and co-ordinating them with a new turret type loader for fast, automatic plunge grinding — it has no unnecessary mechanism.

As traverse grinding is not involved, swivel and sliding tables, hydraulic table cylinder and attendant control valving have been eliminated. Taper adjustments are made in the automatic truing device located in the wheelhead. The base contains no inner mechanism, its sole function is to rigidly support the headstock, footstock, wheel slide and loader.

This machine provides for automatic loading — a new departure from the usual cylindrical grinder design. On the Plunge-O-Matic Grinder the gap in front of the grinding wheel is 19" deep by 18" or 30" work length — ample space to accommodate the new turret loader. And since one type of loader can handle many parts, only the loader insert, which actually holds the parts, needs specific designing. This reduces the original cost and operating maintenance of automatic loading.

The Plunge-O-Matic wheel slide, unitized and entirely independent, carries grinding wheels of 30" or 36" diameter and can be located as desired on the base. Complete flexibility for angular grinds is assured, and heavy duty grinding with wide or multiple wheels can be provided for.

Your Norton Sales Engineer, a trained specialist in grinding, will be glad to give you more facts about the Plunge-O-Matic Grinder — with an accurate estimate of how much you can save. NORTON COMPANY, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada.* J. H. Ryder Machinery Co., Ltd., Toronto 5.

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries

NORTON

GRINDERS *and* LAPPERS

Making better products
to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEAR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

THE GREAT STRENGTH OF N-A-XTRA LETS YOU ELIMINATE COSTLY DEAD WEIGHT FROM YOUR PRODUCTS

N-A-XTRA is the best low-alloy, extra high-strength steel you can buy. Heat-treated, fully quenched and tempered, it's now available in minimum yield strength levels of 80,000—110,000 psi. This is nearly three times the strength of ordinary carbon steel.

The great strength of N-A-XTRA gives engineers and designers a unique opportunity to eliminate bulky, useless dead weight from finished products. Production men will delight in its superior formability and superb weldability. Send today for our illustrated brochure on N-A-XTRA HIGH-STRENGTH steel. Great Lakes Steel Corporation, Detroit 29, Michigan, Dept. **X-8.**

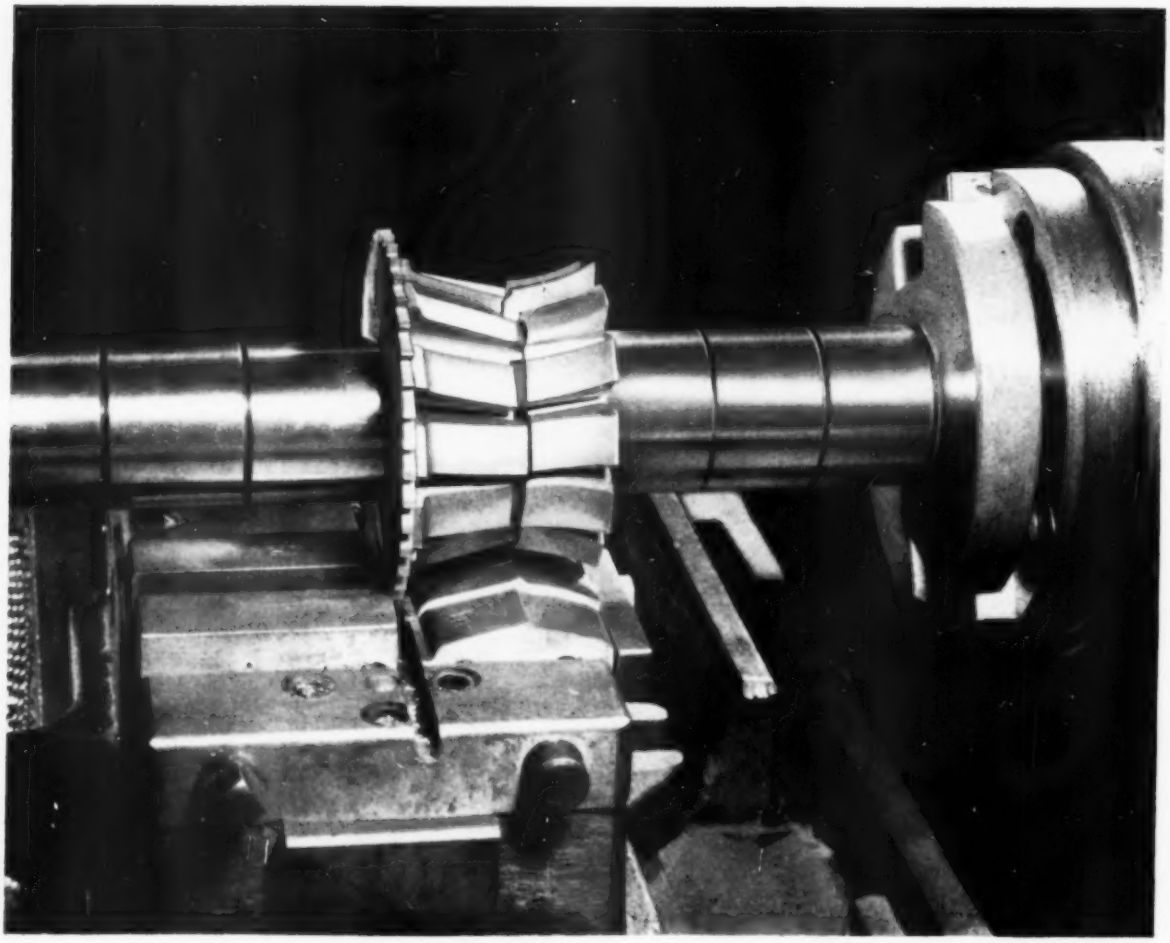
N-A-XTRA

GREAT LAKES STEEL

A DIVISION OF NATIONAL STEEL CORPORATION

Mill Odd Shapes in One Operation

...with Barber-Colman Form-Relieved Cutters



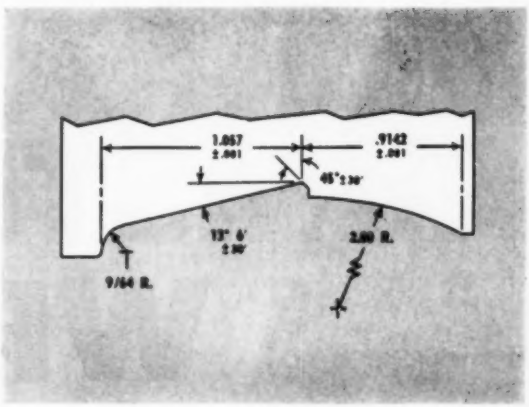
Milling is the best way to produce accurate, irregular forms with a minimum of tooling expense. But, when you get down to cases, much depends on the design and quality of the milling cutter used.

Barber-Colman Company will manufacture a cutter from your part or print for almost any form. In it will be designed all the factors needed to upgrade production efficiency and work quality.

Take this small part, for example. As shown on the drawing, there are two opposed surfaces that require machining at right angles to the cutter axis. For efficient milling at these points, the teeth must have both left-hand and right-hand axial relief. This design problem was solved by making the tool interlocking, with axial relief in both directions. Right-hand and left-hand helical flutes assure smooth cutting action and fine finish.

The cutters are *unground*. Yet, all dimensions are held to a maximum tolerance of ± .002 in. Angular surfaces are held to ± 30 minutes. A separate cutoff operation was eliminated by ganging a metal-slitting saw with the form cutters.

Thus, fine finish and high accuracy were provided at the lowest possible cost and with a minimum tooling expense.



Five types of engineering . . .

These Barber-Colman engineering and manufacturing capabilities can be added to your own in finding better solutions to milling problems:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.

2. *Design engineering* — highly specialized tool engineering, backed by electronic computers for fast, accurate calculation of complex tooth forms.

3. *Metallurgical engineering* — specially selected steels and heat treatment for your particular material and tool geometry.

4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and any cutter style.

5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

If you are producing irregular parts by shaping, crush grinding, or milling, it will pay you to let a Barber-Colman milling cutter engineer look at the job. He will show you how to combine the maximum number of operations in a single cut with lowest possible tool cost. Call your Barber-Colman sales office or Rockford — TR - 7-5741.

Barber-Colman Company

BARBER COLMAN

61 Loomis Street, Rockford, Illinois

Fine tools that encourage Good Work

ARMSTRONG WRENCHES

An ARMSTRONG Wrench feels right—is balanced. It goes over nuts or screw heads easily, grips firmly without sloppiness, won't round corners—because openings are carefully machined to correct sizes. It's safe, strong beyond need without clumsy bulk—because of superior design and selected steels, heat treated to proper degree of hardness and tensile strength. It's quality finished, ARMALOY (alloy steel) Wrenches in chrome plate with heads buffed; HI-TEN (carbon steel) Wrenches in baked-on gray enamel with heads ground bright . . . all plainly marked for size. All are uniformly excellent tools manufactured under strict quality control, by modern methods, with modern equipment in a modern tool plant . . . 1537 different industrial sizes and types—single wrenches, or sets in metal cases, boxes or rolls . . . each a quality tool. Armstrong Wrenches are "Fine tools that encourage good work."

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

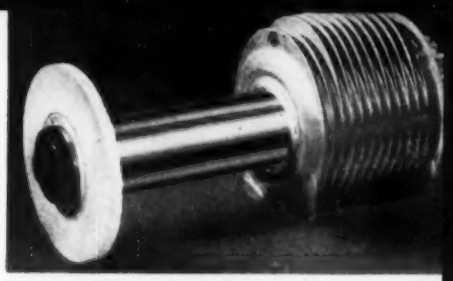
If you don't know your local ARMSTRONG Distributor, we will send you the names of those in your area.

ARMSTRONG BROS. TOOL CO. 5215 W. ARMSTRONG AVE. · CHICAGO 46, U.S.A.

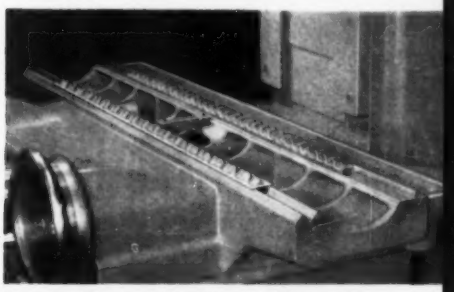
For the **best buy** in high precision surface grinders

Landis Abrasive 618—built to Landis precision grinder standards

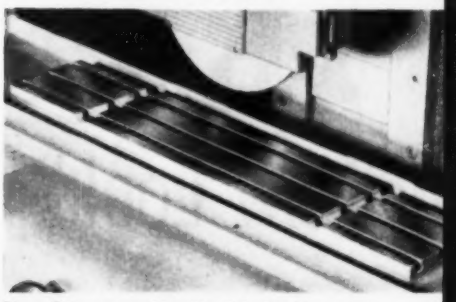
For full details request catalog 618-59



Accuracy with Heavy Stock Removal—Unit motorized spindle, dynamically balanced. Supported by two super precision preloaded bearings at each end.



Accurate Slot and Shoulder Grinding—Roller bearing ways with backlash eliminator on saddle assure positive accuracy.



Close Tolerances—Heavily ribbed table, extra thick saddle and widely spaced ways assure accuracy even under overload conditions.

Sensitive Precision Controls—Feed increments of .0001" on head. Crossfeed graduated in .001" with adjustable vernier in .0001".

ABRASIVE
precision surface grinders

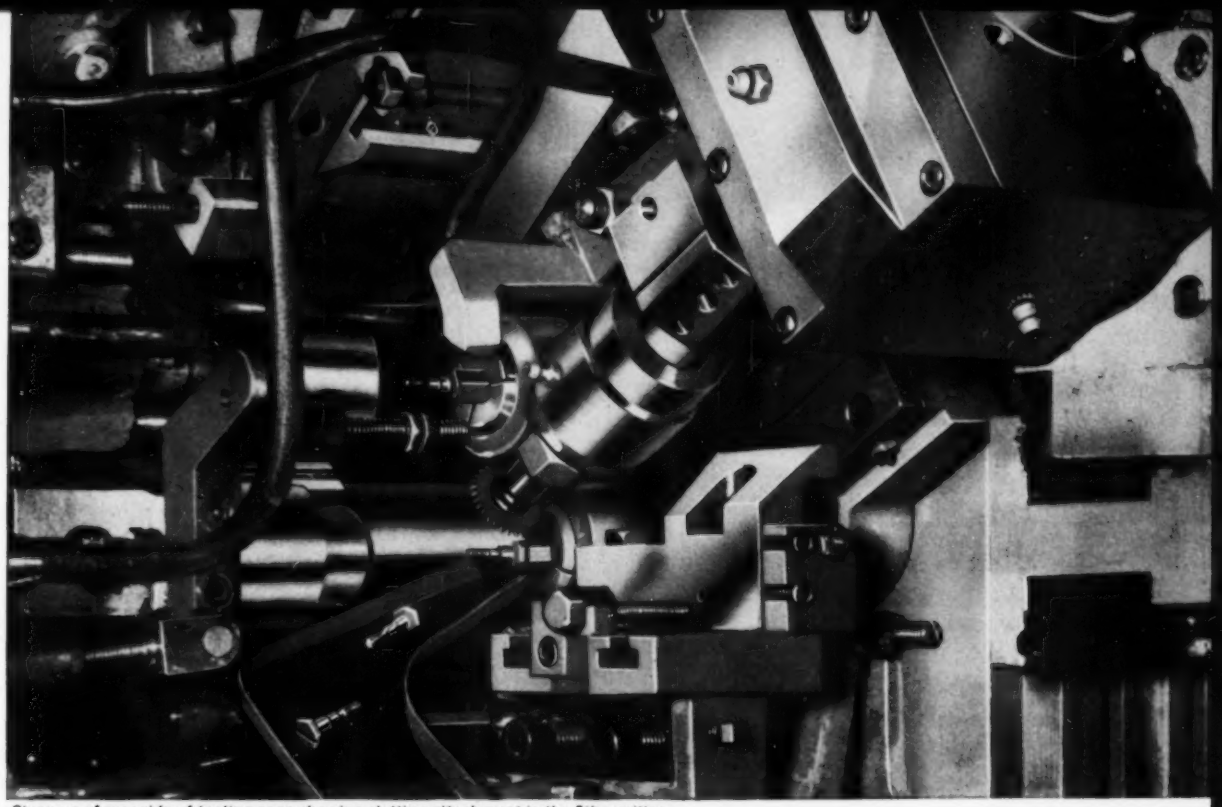
a product of
LANDIS TOOL
world's largest manufacturer of precision grinding machinery
WAYNESBORO, PENNSYLVANIA

First Precision Component
in the Run . . . or Last

Acme-Gridleys Sustain Exacting Tolerances for IBM®'s "New Look"

An eight unit battery of ⅜" RA-6 Acme-Gridleys.

CIRCLE 175 READER SERVICE CARD

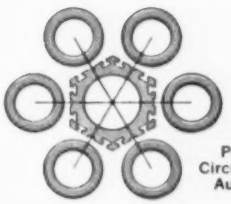


Close-up of rear side of tooling zone showing slotting attachment in the 5th position.

At IBM's modern Lexington, Kentucky plant, twenty Acme-Gridley 7/16" six spindle automatics are mass-producing the small to miniature parts for their sleek new electric typewriter. They help to provide IBM with greater *sustained* accuracy at lower cost than other comparable machines.

The precision components are held to closely controlled tolerances of .0005 t.i.r. These limits apply to the last piece in the run as well as the first, and consistent accuracy is maintained with less machine adjustment than ever before realized. Sustaining the closely controlled tolerances of these parts completely minimizes costly rejections during exhaustive quality control checks of the completed units. Inspection time is greatly reduced.

IBM has also found that the wide-open tooling zone of their 7/16" Acme-Gridleys permits much greater latitude in tooling up for complicated operations performed in a single set-up. This, plus the lasting accuracy of direct camming and the flexibility of independently operated toolslides, makes this newest member of the Acme-Gridley family a profitable asset to IBM's modern production line. Write for Bulletin

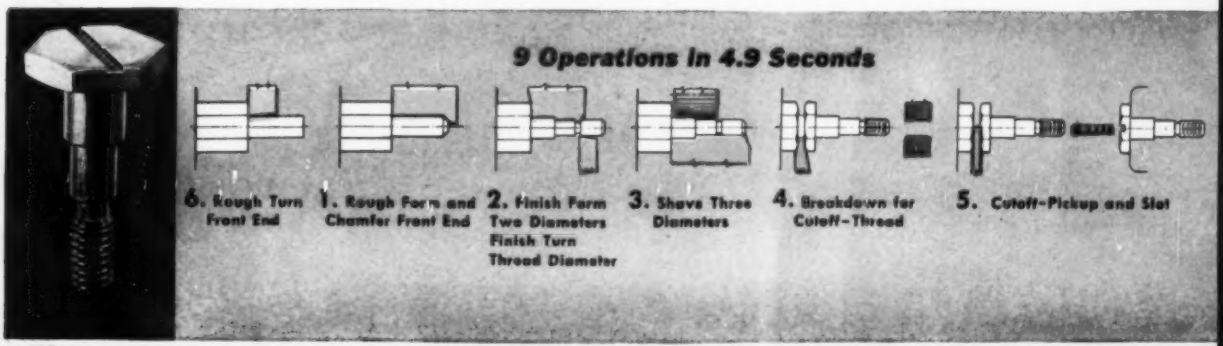


Pioneer in Circumferential Automation

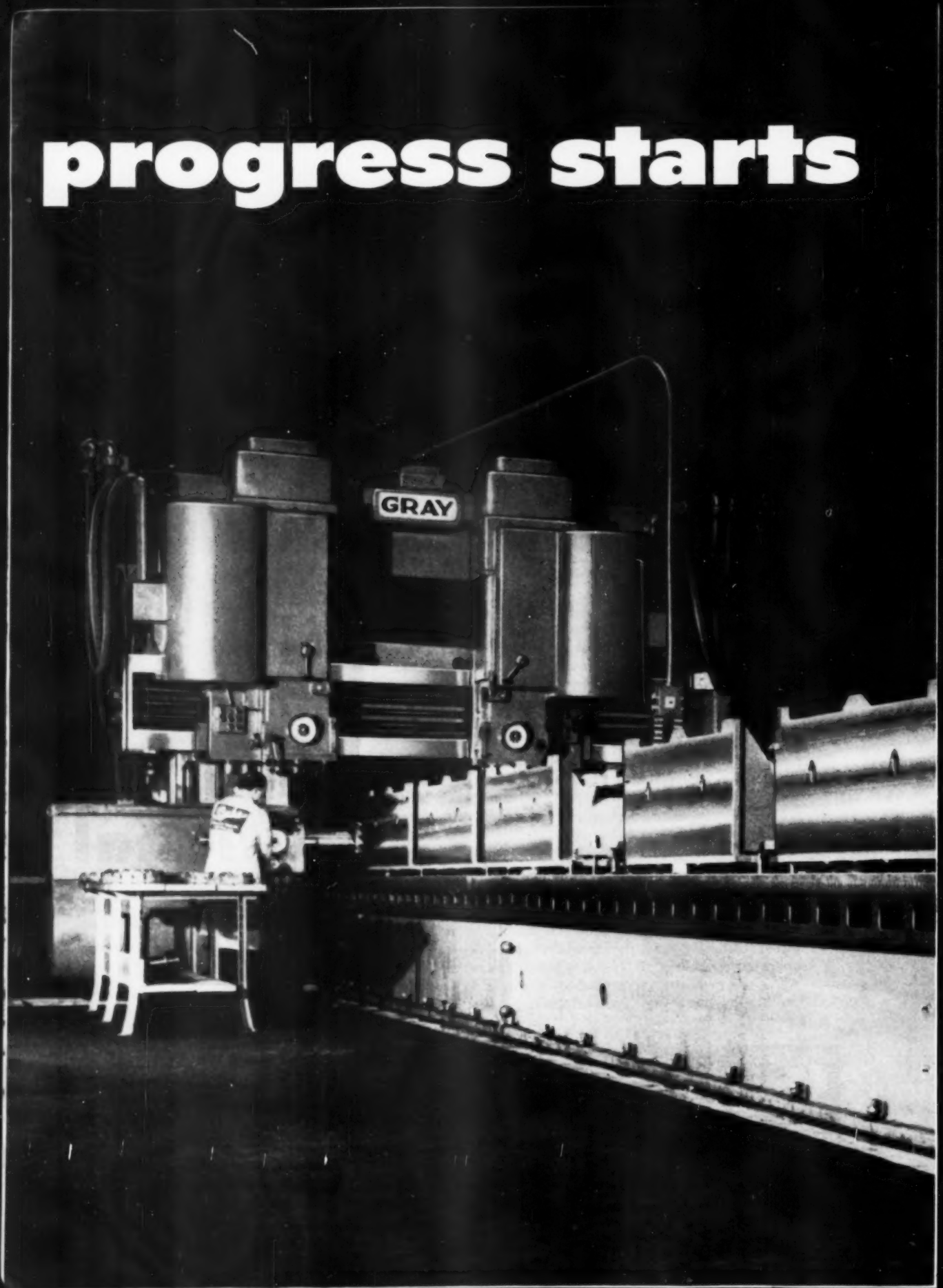
National Acme

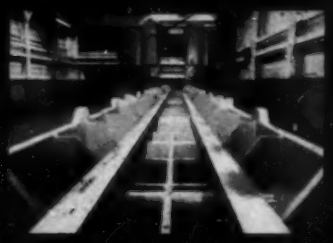
The National Acme Company
171 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.


9 Operations in 4.9 Seconds
6. Rough Turn Front End
1. Rough Form and Chamfer Front End
2. Finish Form Two Diameters Finish Turn Thread Diameter
3. Shave Three Diameters
4. Breakdown for Cutoff-Thread
5. Cutoff-Pickup and Slot

progress starts

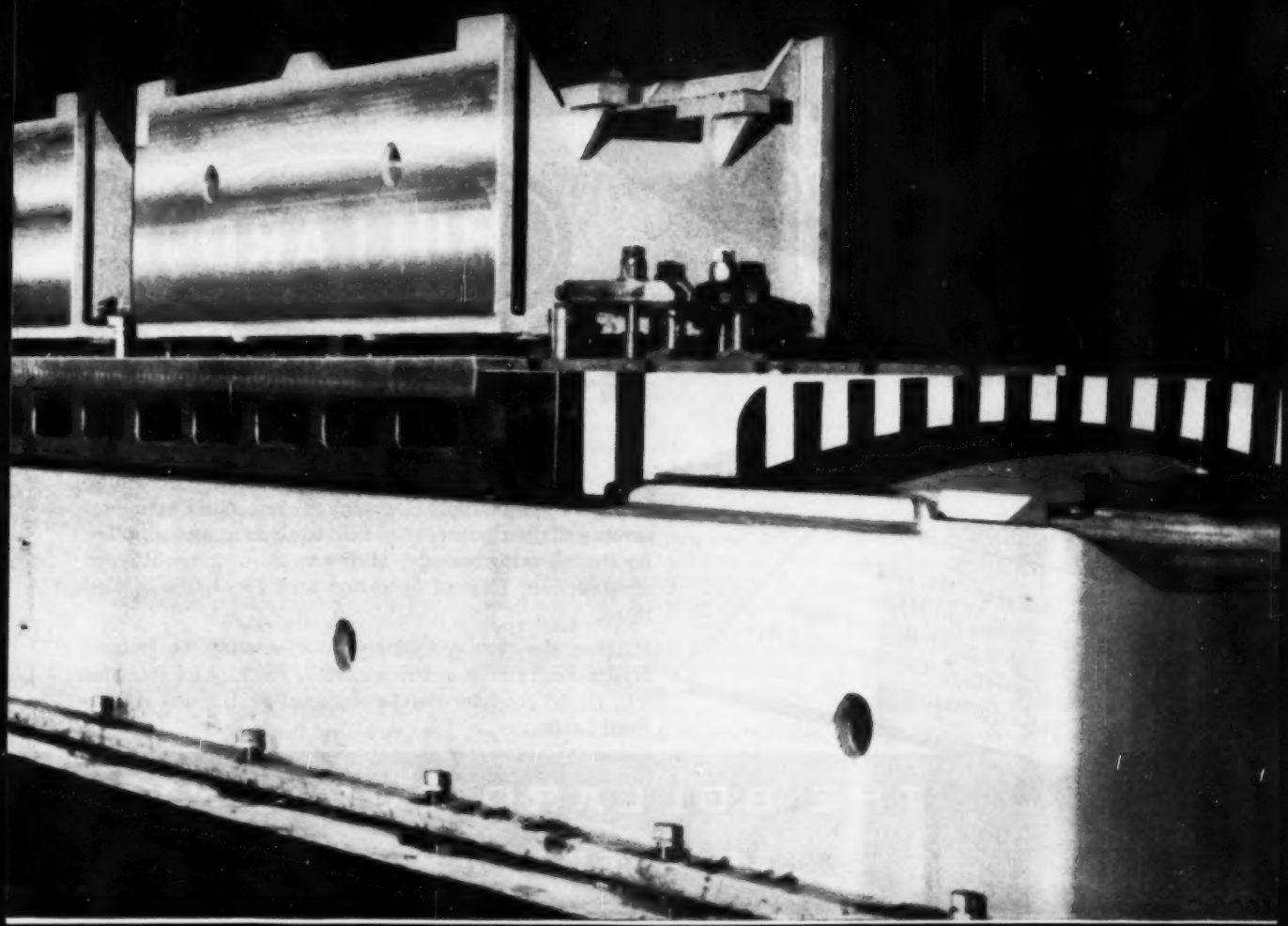


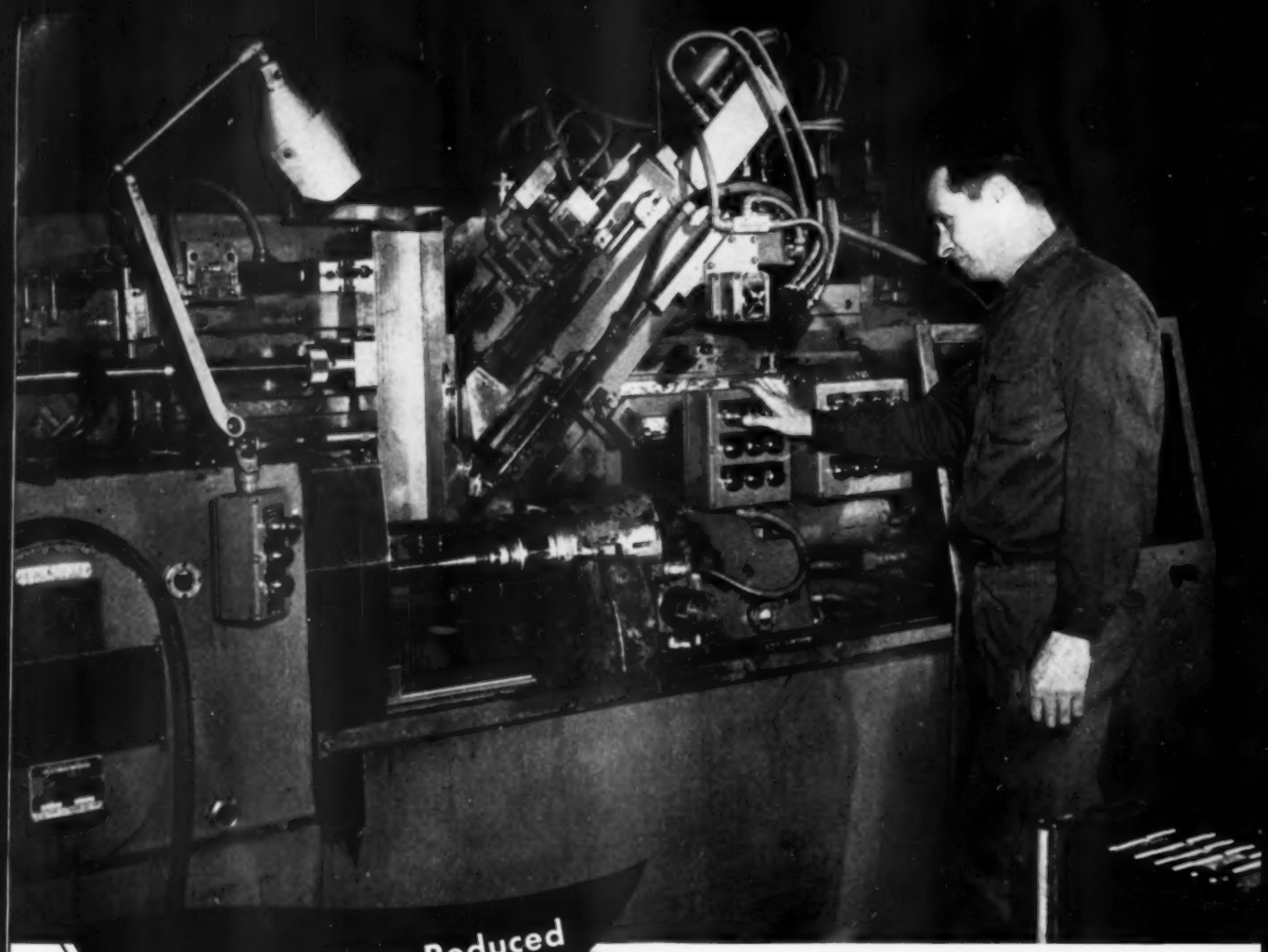
on  a GRAY

What you see being milled on this big 105 foot long Gray, are transfer machine bases of the future...six at a time...automation production machines of Buhr Machine Tool Co., of Ann Arbor, Michigan. It's logical that this company, engaged in producing cost cutting, time saving equipment, should select a cost cutting, time saving Gray todo the job.

Gray unit head planer type millers dominate the field of modern heavy duty milling. This 66" x 66" x 50' giant can simultaneously deliver 300 H. P. to its four cutters. Duplex tables virtually eliminate idle time by permitting work set-up on one section, while work is being milled on the other section. Unusually simple control encourages maximum operator efficiency. All this, plus mirror smooth surfaces milled to precise tolerances maintain the Gray reputation for top quality the world over.

The G. A. GRAY Co., Cincinnati 7, Ohio





Machining Time Reduced Over 25%

on Valve Bodies with . . . . . .

BULLARD

HYDRA-FEED LATHE

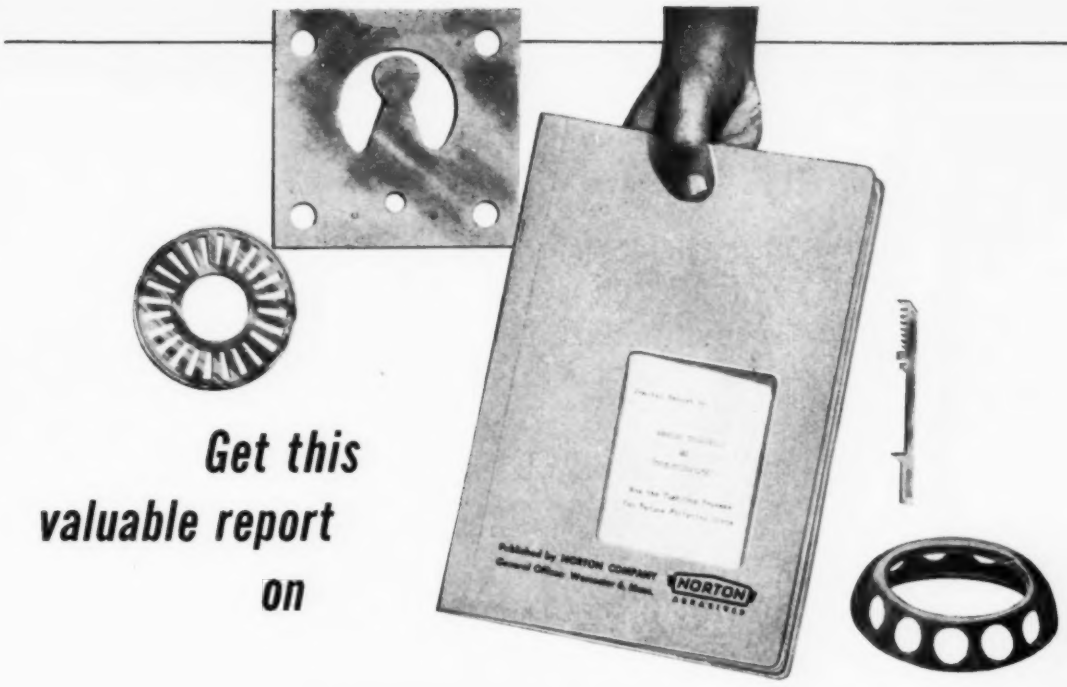
This "dollars and cents" saving is made possible, according to the National Supply Company, Toledo, Ohio, manufacturers and distributors of oil field equipment and supplies, for the following reasons: Minimum set-up time; Rugged construction; Ease of operation and Flexibility of feed rates.

Further, they are completely satisfied with the Bullard Hydra-Feed and, if ordering another machine for the same job, would consider purchasing another Bullard Hydra-Feed Lathe.

You, too, will share this enthusiasm for the Bullard Hydra-Feed Lathe — ask your Bullard Sales Engineer, Distributor or write for full information to

THE BULLARD COMPANY

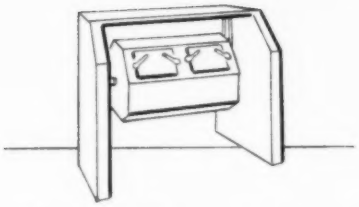
BRIDGEPORT 9, CONN.



Get this valuable report on

The best ways to finish metal stampings

from your Norton Representative



Newest in the Norton series of reports to industry is *Barrel-Finishing of Metal Stampings*, prepared by Norton engineers.

Based on continual observation of finishing techniques in many plants, this report brings you plenty of worthwhile information on the advantages of barrel-finishing equipment and abrasives. Included are facts on improving fatigue resistance of metal stampings . . . types and sizes of stampings you can barrel-finish . . . and reports like the following:

Cylindrical, steel-cage stampings had many slots with burrs on edge of each slot. Requirements were: removal of burrs, forming slight radii on all edges, improving surface finish. A large finishing barrel was charged with random-shaped ALUNDUM* TUMBLEX* *"A" abrasive chips in a water solution level with the top of the mass. All operations were completed in one run and thousands of parts were barrel-finished in one day.*

Aircraft panel stampings, 12" square x ⅛" thick, perforated, were processed by placing 12 panels 1" apart, using steel rods with fiber bushings as spacers. This whole unit was placed in the barrel, where bonded, triangular-shaped ALUNDUM TUMBLEX *"T" chips successfully removed all burrs from the stampings' edges and perforations.*

Your Norton Representative can supply you with this report fast — will also provide literature on all TUMBLEX abrasive types: "A" (random-shaped chips), "T" (bonded triangles), "S" (bonded spheres), and "N" (natural stones), covering the widest range of finishing requirements. And samples of your work parts sent to our Sample Processing Department will be promptly barrel-finished and returned to you with complete facts as to abrasives, methods and equipment. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world. G-371

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

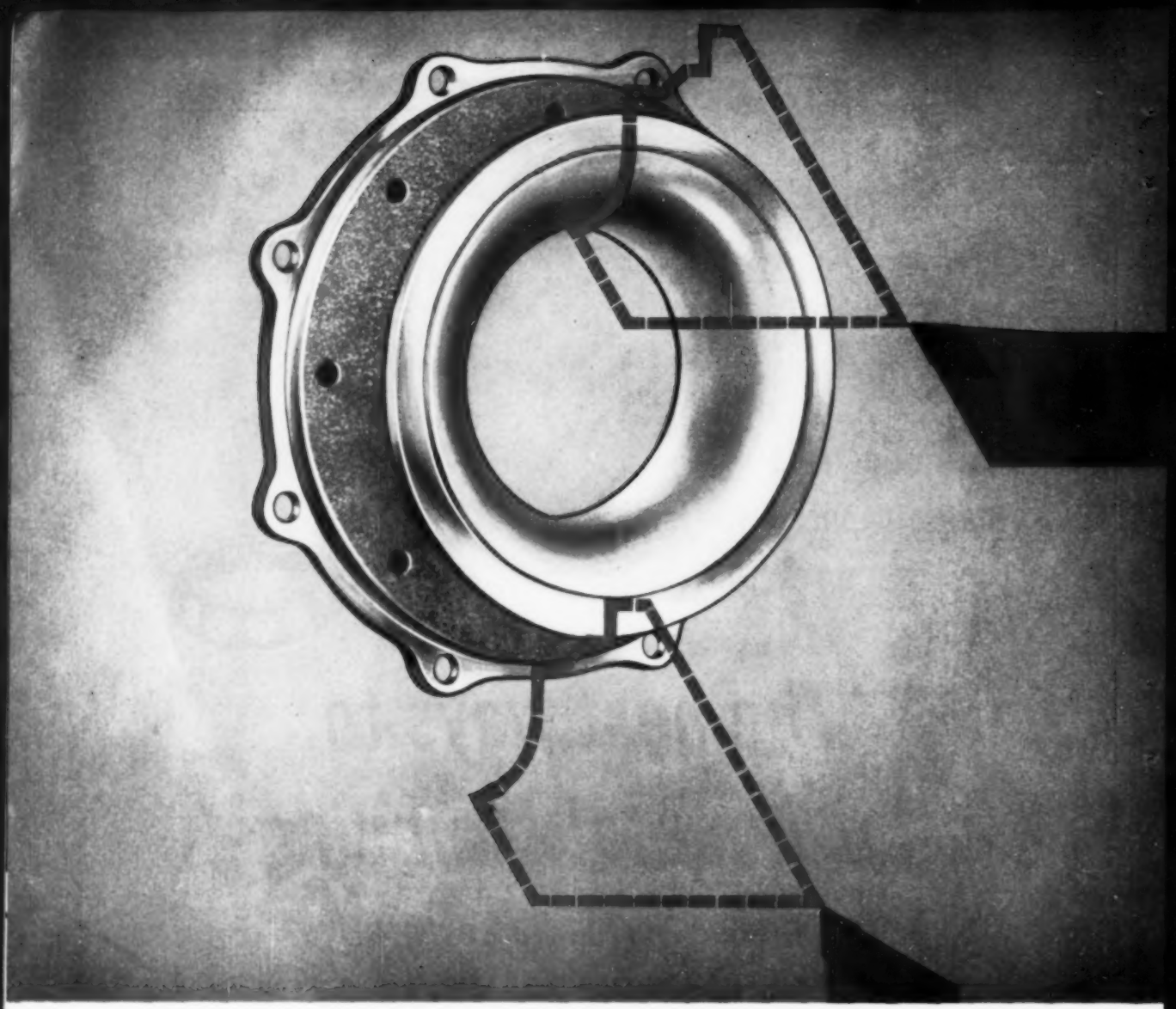
NORTON
ABRASIVES

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

◄ CIRCLE 179 READER SERVICE CARD

CIRCLE 180 READER SERVICE CARD 31



seven *surfaces to turn:* **one** *template,* **one** *slide,* **two** *tools.*

Machine tools are rarely if ever bought because somebody thinks they might come in handy. They are bought because a specific job needs to be done and because a particular machine is judged best fitted to do it. However, no matter how specific your need may be, *versatility* is the greatest by-product you can buy, and the greatest assurance of a profitable investment.

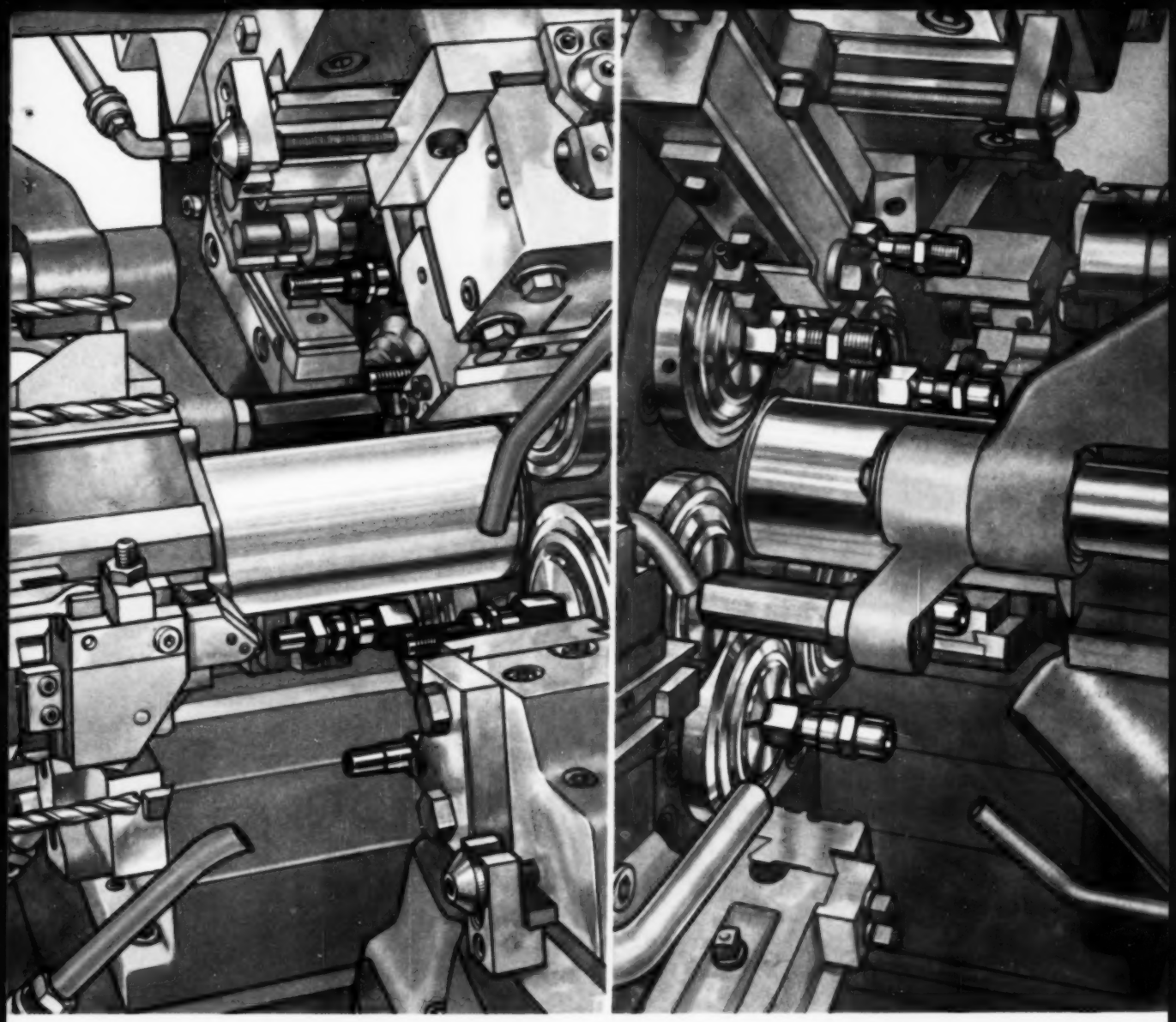
Perhaps your problem is economical, long-run production of a contoured shaft piece. Well and good: your best bet is a New Britain +GF+ copying lathe. Now let's suppose you develop a requirement for only a few hundred pieces like the one illustrated. Your New Britain +GF+ is every bit as efficient. Simple tooling; fast setup; rapid, accurate production.

The applications for contour turning are very broad. If you have contour turning, boring and facing work on shafts or chucking work, you should be interested in the New Britain +GF+. Many shops whose production requirements wouldn't justify very expensive, lightning-fast production can make highly profitable use of one of the basic models because of its versatility, accuracy, fast setup and inexpensive tooling. At the other end of the scale,

you can't touch our machines for tremendous volume work. Obviously, this subject is much too broad and too important to do justice to it here. We would like to send you literature that spells things out in much more detail. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

CIRCLE 181 READER SERVICE CARD

CIRCLE 182 READER SERVICE CARD ►

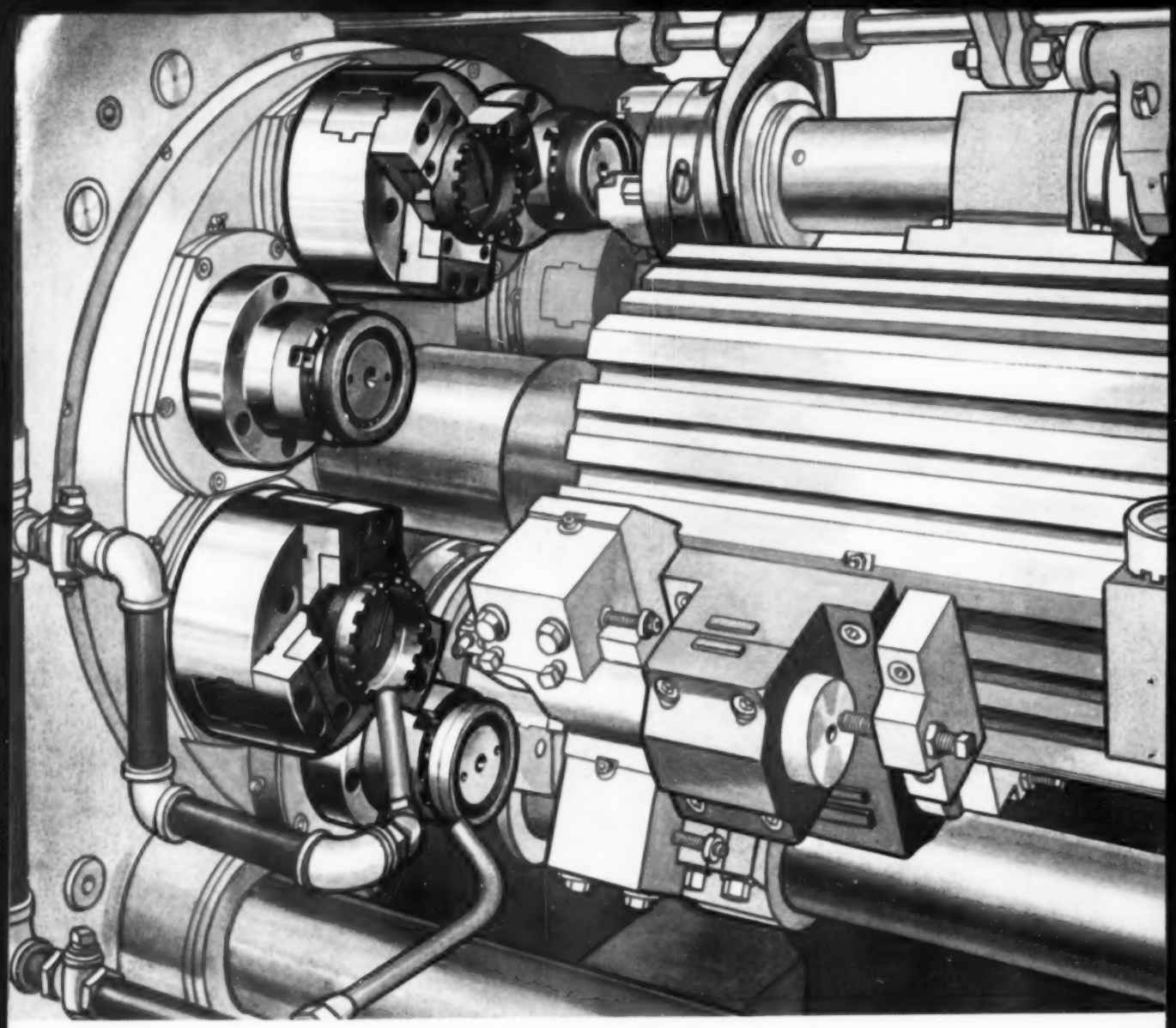


stainless, **225** *per hour—brass* **1500** *per hour.*

Up to a point increased machine productivity is a matter of refinements, additions, skillful tooling and perhaps more power. Eventually you achieve about all the efficiency that can be built into equipment of conventional design.

To achieve a major break-through in bar machine productivity necessitated redesign from the ground up. New Britain has done it with such success that we are able to offer the metalworking industry a whole new family of machines with performance unequalled anywhere. Independently cammed cross slides open up a whole new world of tooling possibilities. Power and spindle speeds are adapted to the important new metals and alloys. Increased chucking capacity allows application of New Britain standards of speed and accuracy to much larger pieces. None of the famous New Britain exclusive features which preserve accuracy and increase accessibility over other machines have been sacrificed. The chart below tells part of the story, and we have complete literature available to spell it out completely on the models which interest you particularly. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.	Weight
45	4	4	43-526	5"	30-50	46,000
52	6	6	271-4250	1 1/4"	15-25	12,800
62	6	6	177-3000	1 5/8"	15-30	18,800
62	6	6	177-3000	2 1/4"	20-30	18,875
82	6	6	64-633	3 1/2"	30-50	46,000
83	8	6	99-1504	2 5/8"	30-50	46,000



open secret *of New Britain superiority.*

Wide-open design makes the most fundamental difference between a New Britain automatic chucking machine and other machines. It speaks for itself as a means of getting at the tooling, making adjustments and clearing chips.

Massiveness, right from the floor up, is equally apparent and equally important in chucker work. You see it in the way the cutting tools make the heaviest cuts with a chatter-free smoothness that can't be duplicated.

Only New Britain provides a combination of longitudinal with transverse forming motion where needed. This versatility eliminates the need for second operation machines in many cases —particularly when a job is setup for double indexing, as illustrated above.

New Britain spares no pains to incorporate every new development to make chucker-type machining more profitable. The open-end design lends itself particularly well to magazine loading and unloading, for example, and many New Britains are being equipped to provide this feature.

Whenever a number of operations are required on cast or forged pieces, these massive, rugged, powerful machines offer great possibilities for savings through faster, more accurate, more reliable production. A new and complete catalog on the New Britain chucker line is just off the press. We would be very glad to send you your copy. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Announcement

New Britain's new and completely modern Rebuild-Retool Center at Bridgeport, Michigan, is important to every present and prospective owner of New Britain Automatics.

This is the first center established exclusively for the rebuilding and retooling of production machinery. It is staffed by men trained specifically for this type of work. It is equipped specially for putting New Britains back on the job with maximum efficiency in minimum time, at minimum expense to the owner.

Rebuilding and retooling may be "orphan jobs" elsewhere, but they rate top treatment at New Britain. Here is an important extra reason for selecting a New Britain when you purchase new equipment—a full time specialist organization devoted to protection of your investment.

If you would like to investigate the profit potential in a complete modernizing program, or could profit from a factory-engineered retooling of one or more machines, write us either at New Britain, Connecticut, or Bridgeport, Michigan. The New Britain Machine Company.

Correct Lubrication in Action...

Fastener company cuts

Here some of the billions of fasteners produced by United-Carr Fastener Corporation undergo pickling bath before being plated. This company is a leader in the production of fasteners of all kinds for all industries.

Mobil

Complete Engineering Program
Proved Petroleum Products

Mobil

maintenance costs 40%

Here's how United-Carr Fastener Corporation saved over $37,000 with the help of Mobil Correct Lubrication!

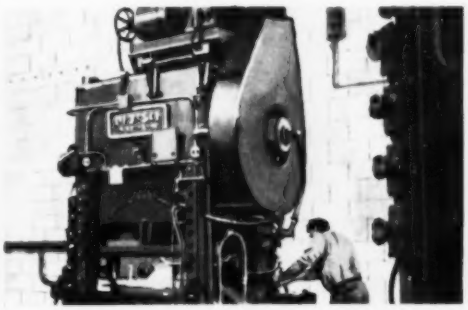
United-Carr Fastener Corporation manufactures thousands of types of metal fasteners, stampings, and plastic-to-metal components . . . brings out hundreds of new products every year. To maintain a competitive edge, costs must be kept to a bedrock minimum.

Records of the company's Carr Fastener Division show that along with capital improvements, a Mobil Program of Correct Lubrication helped lower maintenance costs per machine hour 40% last year. Overall savings during a period of over 3 years amount to $37,000.

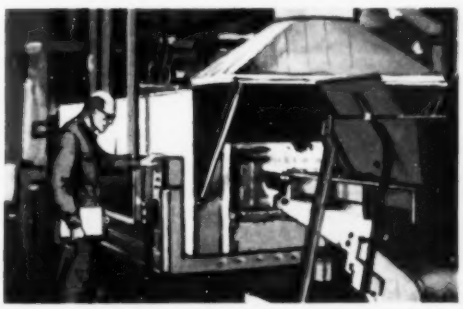
Mobil engineers and plant personnel studied savings possibilities. Maintenance schedules were carefully planned to cut machine servicing time. Mobil laboratory analyses of lubricants were helpful in solving downtime and severe-wear problems. Mobil recommendations for improvements in lubrication system helped lengthen machine life. In fact, machine downtime has been reduced to a point where maintenance crews no longer need to job out repairs but can handle them themselves.

This is *Correct Lubrication in Action.* Why accept less for your plant?

Clogged oil filters on high-speed presses caused constant shutdowns. Mobil studied lubrication system design—suggested improvements to keep lubricant and machines clean. Contamination was reduced . . . filter replacements cut 50% . . . $1,303 saved.



Bearings and gears on press drive units failed frequently. Mobil investigation indicated abnormal wear. Mobil recommended case-hardened gears and extreme-pressure lubricant. Gear and bearing life doubled . . . $19,934 saved in 31-month period.



Due to high heat and heavy loads, conveyor belt bearings in drying ovens had to be replaced yearly. Mobil recommended a lubricant that cut this expensive time-consuming task—saved Carr Fastener $293 in 24 months.

Severe acid, alkali and wash conditions caused once-a-week bearing failure on tumblers. Mobil recommended more frequent application and inspection. Result—bearing failure almost completely eliminated . . . $4,376 saved in 39-week period.

Correct Lubrication

Another reason You're Miles Ahead with Mobil!

With this Campbell Machine, you can--

Cut 6-inch Diameter Hard Alloys-Cleanly and Accurately-in Less Than 3 Minutes!

• This Campbell wet abrasive cutting machine—the Model 406—will cut tubing, bar stock, angle iron, or any other shape up to 6" round or square—and it will cut practically *any* material, including the new super alloys and exotic metals. Like all Campbell machines, it's designed to give *accurate* cuts, quickly and cleanly.

HIGH SPEED—4 to 8 seconds per square inch is the normal cutting speed for all Campbell wet abrasive cutting machines. For instance, you can cut 6" diameter hardened steel in less than 3 minutes.

ACCURACY—Campbell machines are production machine tools. They cut within close tolerances to reduce rejects and scrap loss. For example, the Model 406 will cut 3" diameter material to lengths within ±.010", 6" diameter within ±.030".

FINE FINISH—Additional finishing operations are rarely required. There is no burn, and burr has been reduced to an absolute minimum.

POWER OSCILLATION—On an oscillating-type machine such as the Model 406, the cutting wheel is moved horizontally back and forth *across* the cut as the wheel is fed downward. The result—greater cutting capacity, with longer wheel life.

PROPER COOLANT APPLICATION—Large reservoir and a 33 gallon/minute pump provide high volume of coolant. Unique Campbell distributor applies coolant equally to both sides of the wheel—an essential requirement for accurate cuts.

OTHER CAMPBELL MACHINES FOR ANY CUT-OFF NEED

Choose from four types of Campbell machines for wet or dry cutting—chop stroke, oscillating, horizontal or rotary—with capacities up to 14" rounds, 12" billets, plate up to 6" thick and 20 ft. long.

Regardless of your application, you'll find that a Campbell machine provides you with the best cut-off method for modern production techniques—far more efficient, accurate and economical for cutting many materials than other cutting equipment.

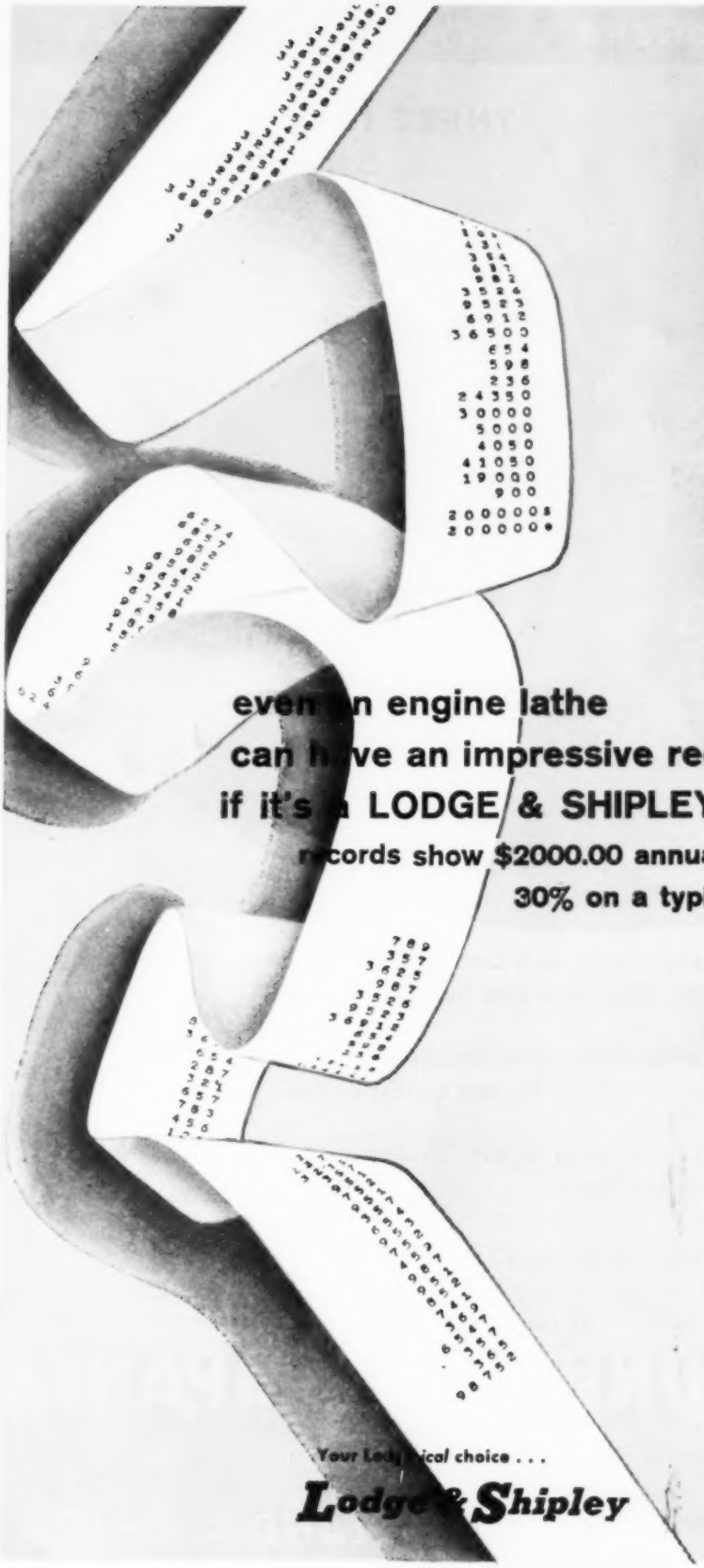
WRITE FOR DETAILS—Bulletin DH-260 gives the complete story on the Campbell Model 406 abrasive cutting machine. We'll also be glad to send you information on other machines; just tell us your cut-off application. And remember—your Allison-Campbell Field Engineer is an abrasive cutting specialist. Call on him for expert advice.

ACCO

CAMPBELL ABRASIVE CUTTING MACHINES

Allison-Campbell Division • American Chain & Cable Company, Inc.

923 Connecticut Avenue, Bridgeport 2, Conn.



Here, a slip joint collar is being turned and bored from a T-6 aluminum blank. Floor-to-floor time is only 25 minutes, a 30% saving in time alone.

even an engine lathe can have an impressive record of savings if it's a LODGE & SHIPLEY POWERTURN

records show $2000.00 annual saving . . . 30% on a typical operation

Significant savings are nothing new on production type lathes but it is something to write home about on an engine lathe. Tacoma Boatbuilding Co., Inc., Tacoma, Washington, liked the accuracy, versatility and output of their POWERTURN Lathe . . . found impressive savings even when this engine lathe was used for non-repetitive operations.

Whatever your turning requirements, consider Lodge & Shipley. Your needs can be filled precisely from a complete range of sizes and types . . . Production, Engine, Toolmaker, Gap, Hydraulic Tracer Controlled and Right Angle Chucking Lathes . . . all designed to provide the best machine for a specific job.

Check Sweet's Machine Tool File, your telephone book Yellow Pages or write direct for literature: **The Lodge & Shipley Company, 3666 Colerain Ave., Cincinnati 25, Ohio.**

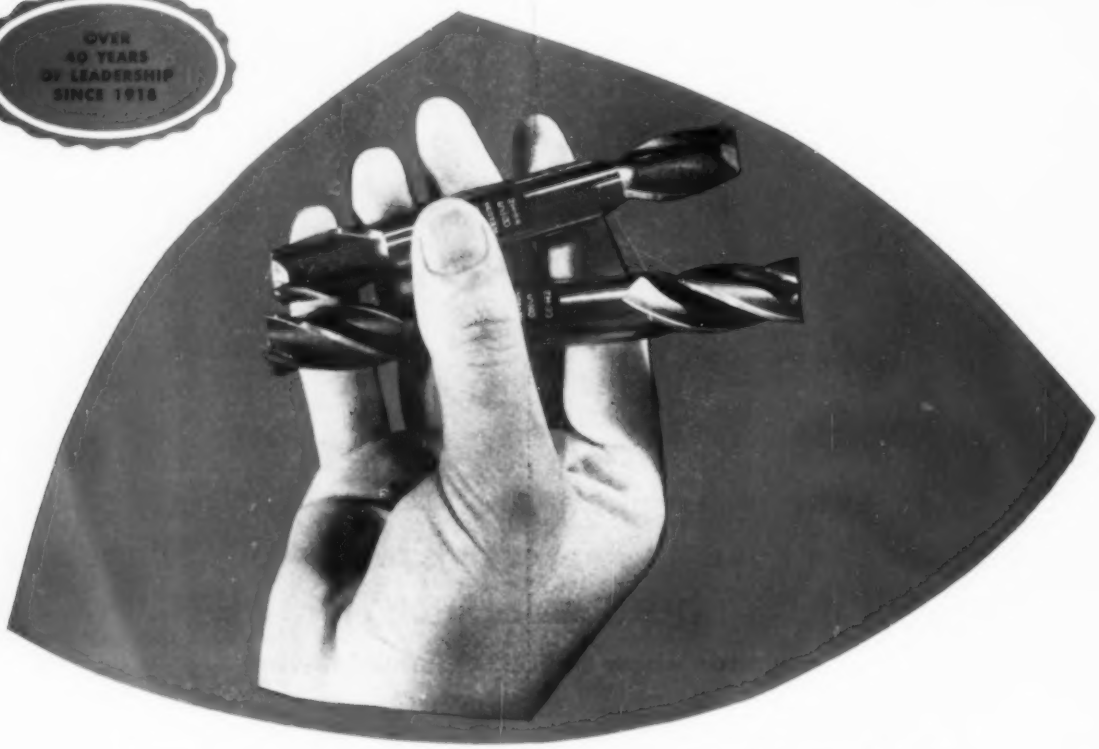
Your Lodge & Shipley choice . . .

Lodge & Shipley

YESTERDAY'S PIONEER . . . TODAY'S LEADER

EXPERIENCE / THERE IS NO SUBSTITUTE!

OVER 40 YEARS OF LEADERSHIP SINCE 1918



40 years' successful experience as a company in the manufacture of cutting tools means that when you buy Weldon tools you are assured of the finest.

For all of these years we have consistently led the field in the origination and production of the highest quality end mills, holders and allied items.

Specialization for 40 years—that is the Weldon record—and the best of cutting tools is the result.

Catalog list numbers are now marked on all Weldon tools and holders as an aid when reordering . . . another WELDON FIRST.

Weldon distributors throughout U. S. A. and Canada carry complete stocks to serve you. EX2

THE WELDON TOOL COMPANY

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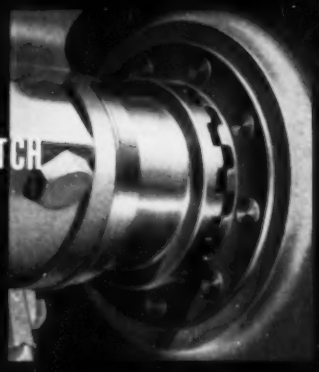
CIRCLE 189 READER SERVICE CARD

CIRCLE 190 READER SERVICE CARD ▶

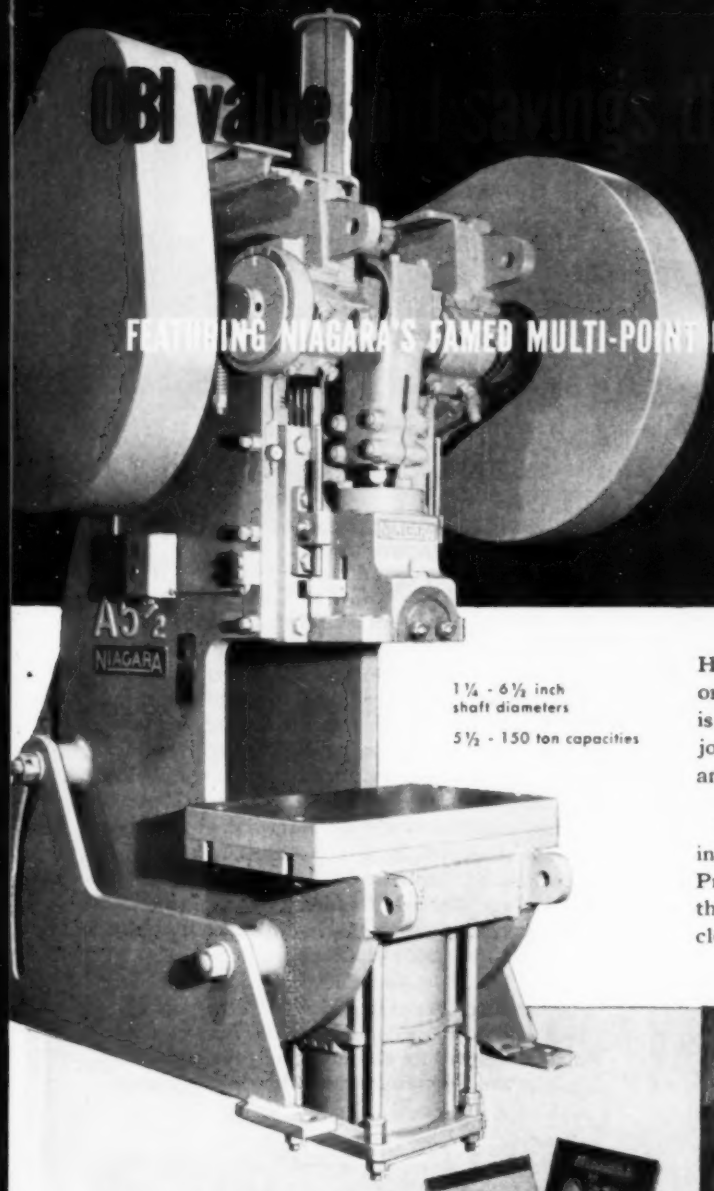
TON FOR TON . . . DOLLAR FOR DOLLAR

OBI value and savings that can't be matched

FEATURING NIAGARA'S FAMED MULTI-POINT MECHANICAL SLEEVE CLUTCH



Picks up load on 14 engaging jaws. Applies driving force concentrically without keys or pins. Assures instant engagement and maximum productive strokes per minute. Needs no air nor electricity. Practically no maintenance. Greater safety: Simplified controls, fewer parts to wear out. *Yes, if permits, inching, too.*



1¼ - 6½ inch shaft diameters

5½ - 150 ton capacities

Here's a workhorse that's known for setting the pace on the most demanding jobs... jobs where the clutch is engaged and disengaged at every press stroke... jobs that call for operation three shifts a day, day in and day out.

Built and *backed* by a company which produces industry's greatest variety of inclinables*. Series A Presses have amassed an unusual success record in thousands of applications. To be specific, let's take a close look at a Series A user:

28 OBI'S SINGLE STROKED 707,140,000 TIMES
WITHOUT ONE CENT SPENT ON CLUTCH ENGAGING SURFACES

Automatically fed for single stroking operations, 28 Series A Presses have produced 707,140,000 parts in the plant of a renowned appliance manufacturer since 1950. Clutches have required but $123.30 in replacement parts. No engaging surfaces have been replaced on any press. Examination shows no measurable wear. Original machining marks still visible.

Write for the complete, documented job study, "707,140,000 Clutch Engagements," as well as Bulletin 58 containing data and specs on Niagara's remarkable line of Series A Inclinables.

*Note: Niagara also builds single and double crank OBI's with Electro-Pneumatic Friction Clutches and Electro-Pneumatic Sleeve Clutches to meet every need. *You name it!*

NIAGARA MACHINE & TOOL WORKS, BUFFALO 11, N.Y.

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NIAGARA (SERIES A) OBI PRESSES

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work

Join the Big Switch to Republic

ELECTRUNITE

HYDRAULIC FLUID LINE TUBING

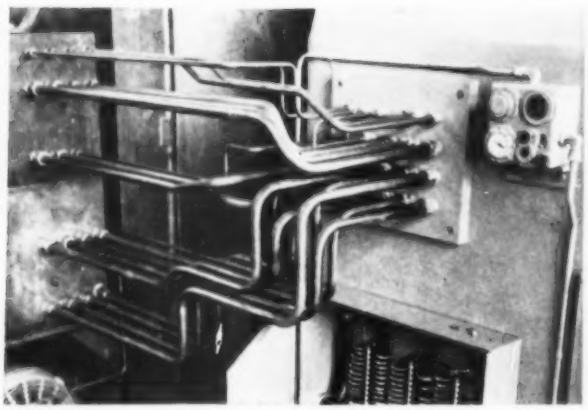
HIGH DUCTILITY assures easy bending in any plane. ELECTRUNITE's uniformly high ductility is the result of double-annealing.

Get more tube per dollar . . . Now Electric Resistance Weld Steel Tubing included in JIC Standards . . .

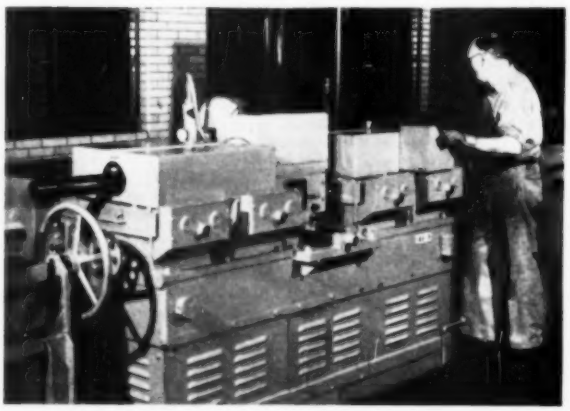
Join the hundreds of manufacturers using millions of feet of Republic ELECTRUNITE® Hydraulic Fluid Line Tubing. As a result of their own tests, many equipment and machinery builders and their maintenance departments switched to this quality-proved hydraulic tubing prior to its being included in the JIC Standard.

Like them, you'll get *more tube per dollar* when you specify Republic ELECTRUNITE Hydraulic Fluid Line Tubing. But initial cost savings are only part of the story. *Savings in downtime* reflect even greater cost reductions!

ELECTRUNITE—produced by the world's largest manufacturer of electrically welded hydraulic tubing—is made from flat-rolled steel. *Prime* steel—checked for defects as only flat-rolled steel can be checked. Then: formed, welded, annealed,



READILY ASSEMBLED—close dimensional tolerances maintained in the drawing of ELECTRUNITE Hydraulic Fluid Line Tubing assure lower-cost installation.



QUALITY YOU CAN MEASURE! Specify FARROWTEST® non-destructive electronic testing to MIL-T-17188 or ASTM-A-178 for extremely critical applications. Offered as an alternate to hydrostatic testing.

ELECTRUNITE IS EASILY FLARED AND BENT BACK upon itself to accommodate standard or flare-type fittings.

cold-worked, and annealed again into a tube of *prime* quality . . . a tube that meets or exceeds the normal life of tubing produced by any other method.

ELECTRUNITE'S uniform walls and concentricity, coupled with uniformly high ductility, assure better bending and flaring characteristics. In the *history* of ELECTRUNITE Hydraulic Fluid Line Tubing, no failure resulting from longitudinal or transverse cracks has been reported.

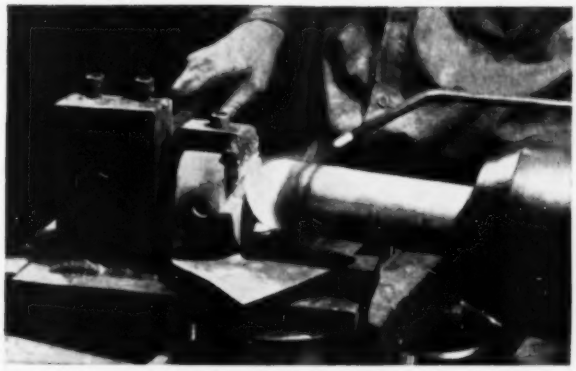
You'll find that ELECTRUNITE Fluid Line Tubing is available in all the sizes shown in the *JIC Standards Book*. Also available in an even wider range of sizes produced to our specification HL-1 (which meets all test requirements of the JIC Standard).

Investigate ELECTRUNITE'S many cost-reducing features. Contact your ELECTRUNITE sales representative or mail the coupon for complete information, including a copy of specifications.

AVAILABLE IN ALL SIZES SHOWN IN JIC STANDARDS BOOK. AVAILABLE IN A WIDER RANGE OF SIZES PRODUCED TO OUR SPECIFICATION HL-1 (WHICH MEETS ALL TEST REQUIREMENTS OF THE JIC STANDARD).

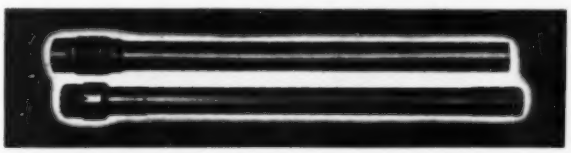
REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products



STAINLESS STEEL TUBING CUT COSTS for Cleveland Process Company, makers of immersion heaters. Brittle material originally used for casing of heating element was expensive, often cracked when scale was removed. Cleveland Process Company solved the problem by switching to Republic Stainless Steel Tubing. ELECTRUNITE Stainless Tubing is strong, easy to fabricate, will save money in the long run. Send for more information.

WORLD'S STRONGEST SHELVING—Republic Wedge-Lock® Steel Shelving—gives you all three essentials of good shelving: a post that will not buckle; a concealed, sway-proof joint; and a reinforced shelf that will not sag. Wedge-Lock's exclusive sway-proof joint actually becomes tighter as the load increases. Berger Division storage engineers can help you design an installation to fit your precise needs. Mail coupon for details.



REPUBLIC DIE-FORM BLANKS REDUCE COST of Ford Tractor power take-off countershafts. Because the Die-Form blank (above) closely approximates the completed part (below), scrap losses are negligible and machining is held to a minimum. Die-Form is a new method of cold forming hot rolled carbon, alloy, or stainless steel bars into multi-diameter blanks ready for final machining. Mail coupon for complete data.

REPUBLIC STEEL CORPORATION
DEPT. AM-8083-A
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send more information on:

☐ ELECTRUNITE Hydraulic Fluid Line Tubing, including a copy of specifications
☐ Stainless Steel Tubing
☐ Wedge-Lock Shelving
☐ Die-Form

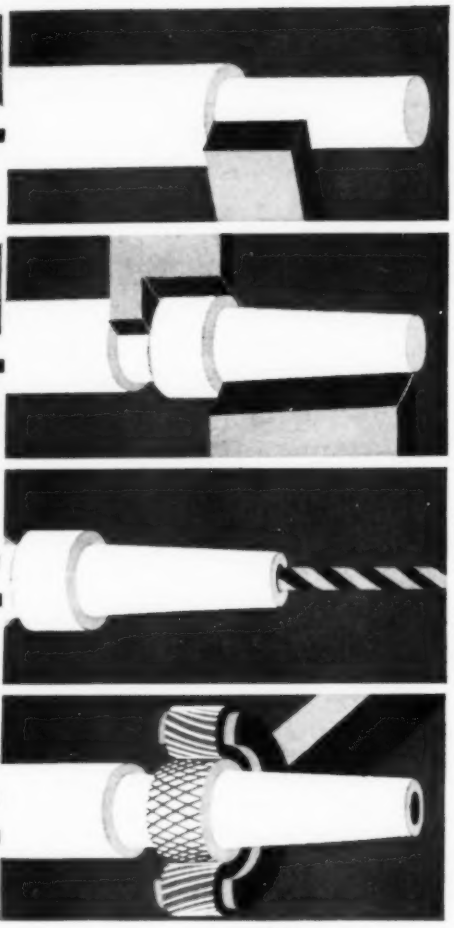
Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

TURN IT FORM IT DRILL IT KNURL IT



it still shapes up to savings

and the savings are only a phone call away!

BRIDGEPORT ALUMINUM

screw machine rod!

For machinability you can't top Bridgeport Aluminum Screw Machine Rod. It cuts easily so your parts can be turned out faster; tooling lasts longer, too. And you can count on consistent high quality with Bridgeport because our skill comes from 94 years of experience in the metals industry.

But the big news in Bridgeport Aluminum Screw Machine Rod is its new availability from Bridgeport warehouses across the country. Now you get faster service locally on the same high specification round and hex rod previously delivered from Bridgeport Mills.

So, for fast delivery on Aluminum, Copper and Brass—where and when you need it—call today:

CHICAGO: LAfayette 3-2230
CLEVELAND: CEdar 1-5180
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DALLAS: RIverside 1-4859
LOS ANGELES: RAymond 3-5101
NEWARK (Hillside): Bigelow 3-0044
NEW YORK: EXeter 2-4290
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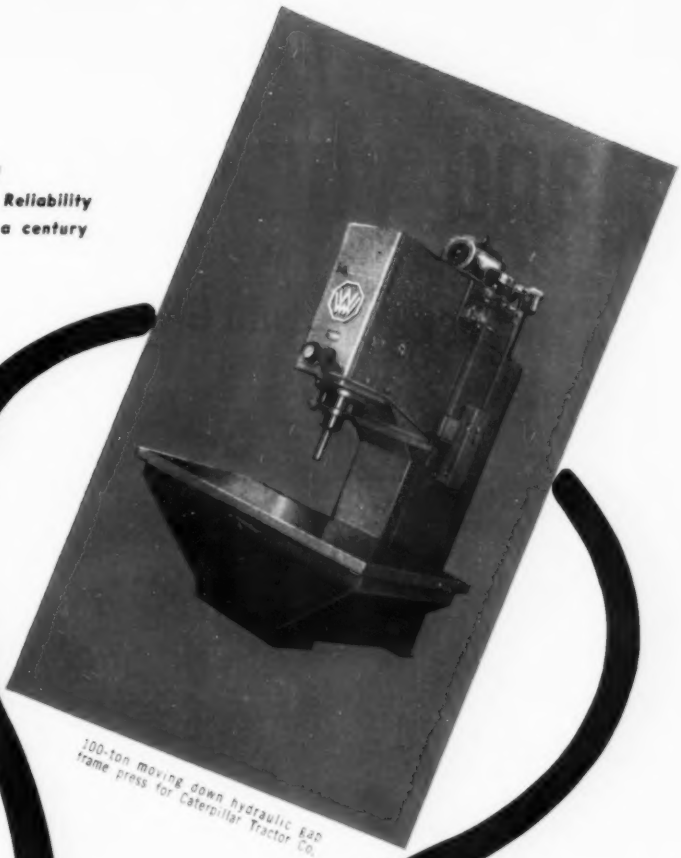
Specialists in Metals from Aluminum to Zirconium

the measure of
Performance Reliability
for more than a century



100-ton moving down hydraulic gap frame press for Caterpillar Tractor Co.

Design simplicity, positive and sensitive controls, trouble-free operation —

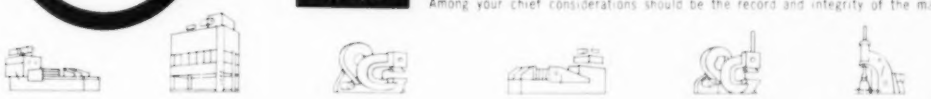
WILLIAMS-WHITE
GAP FRAME PRESSES

Williams-White gap frame presses are bread-and-butter equipment in scores of plants. Production men like their versatility, speed, dependability and economy. Standard sizes, 25, 50, 75, 100, 150 and 200 tons, or built to fit your special requirements as to capacities, opening speeds, daylight, stroke, throat and table dimensions. *Write for Bulletin No. 78.*

106th year

WILLIAMS-WHITE & CO • MOLINE, ILLINOIS

When you buy a machine you buy creative engineering skills and craftsmanship. Among your chief considerations should be the record and integrity of the maker.



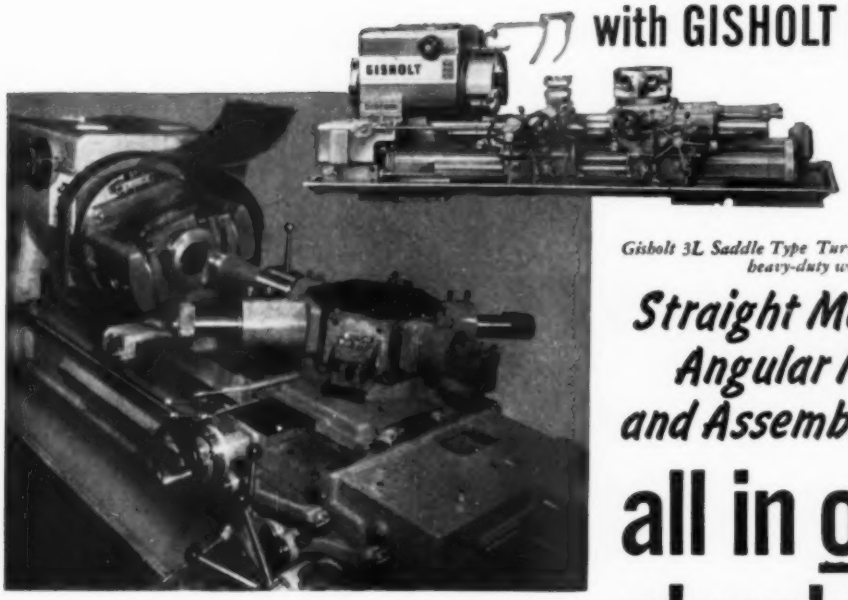
BULLDOZERS PRESSES SHEARS BENDERS PUNCHES HAMMERS

SALES AGENTS: Portland, Ore.: Allied Northwest Machine Tool Corp.; **Los Angeles:** Engen Industrial Co.; **Philadelphia:** Edward A. Lynch Machinery Co.; **Milwaukee:** Pagel Machinery Co.; **Seattle:** Perine Machinery & Supply Co., Inc.; **Chicago:** Polhemus-Miller Co.; **Pittsburgh:** Frank Ryman's Sons; **Cincinnati, Columbus** and **Dayton:** Seifreat-Elstad Machinery Co.; **St. Louis, Kansas City** and **Tulsa:** Robert R. Stephens Machinery Co.; **Buffalo:** H. D. Thweatt Co.

Nice work if you can do it...

and you can...

with GISHOLT Turret Lathes...



Gisholt 3L Saddle Type Turret Lathe—one of five sizes for heavy-duty work of all kinds

Straight Machining... Angular Machining and Assembly...

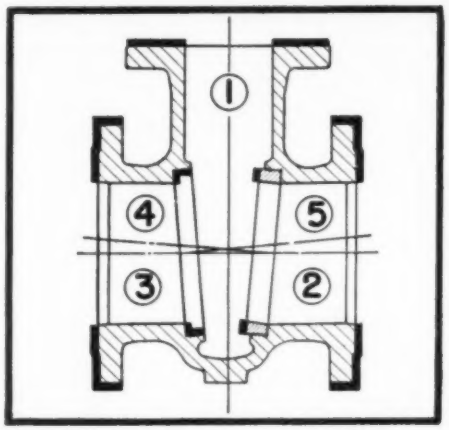
all in one chucking!

Talk about time-cutting ideas, here's the versatility of a Gisholt 3L Saddle Type Turret Lathe paying off again.

All operations required to machine these gate valve bodies are done in a single chucking with a five-position indexing fixture. In addition to machining the bonnet and the two ends, the recesses for the two seat rings are bored and threaded at a five degree angle.

Then the seat rings are inserted—and tightly screwed in place with a driver mounted on the turret. The driving is done with a constant torque—adjustable to suit each job. The final operation is finish facing the seat ring after it is in place with the cross-feeding turret.

Gisholt Engineers have storehouses of ideas to help you increase your production. Ask one to call.



GISHOLT MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

MASTERLINE GISHOLT SINCE 1887 GISHOLT

ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

Hoover pillow blocks with ductile cast housings

Hoover introduces a new, economical pillow block ball bearing unit with cast housing of ductile material that absorbs shock and vibration, assuring long bearing life. It is designed to carry light loads at normal speeds.

The unit contains a pre-lubricated bearing featuring ultra-smooth *Hoover Honed* raceways and a perfectly matched set of *Micro-Velvet* balls, a guarantee of unexcelled quality. Known as the E D series, these new pillow block bearings are available in shaft sizes from ½" to 1 3/16".

Hoover also offers a cast iron pillow block bearing for light to medium load conditions, plus a wide range of flange and machine units.

hoover®
BALL AND BEARING COMPANY
5400 South State Road, Ann Arbor, Michigan
Sales Offices and Warehouses: 2020 South Figueroa, Los Angeles 7, California; 290 Lodi Street, Hackensack, New Jersey

Hoover Honed and *Micro-Velvet* are Hoover trademarks.

NEW BULLETIN 106 DESCRIBES COMPLETE LINE OF NEW HOOVER PILLOW BLOCK BALL BEARINGS!

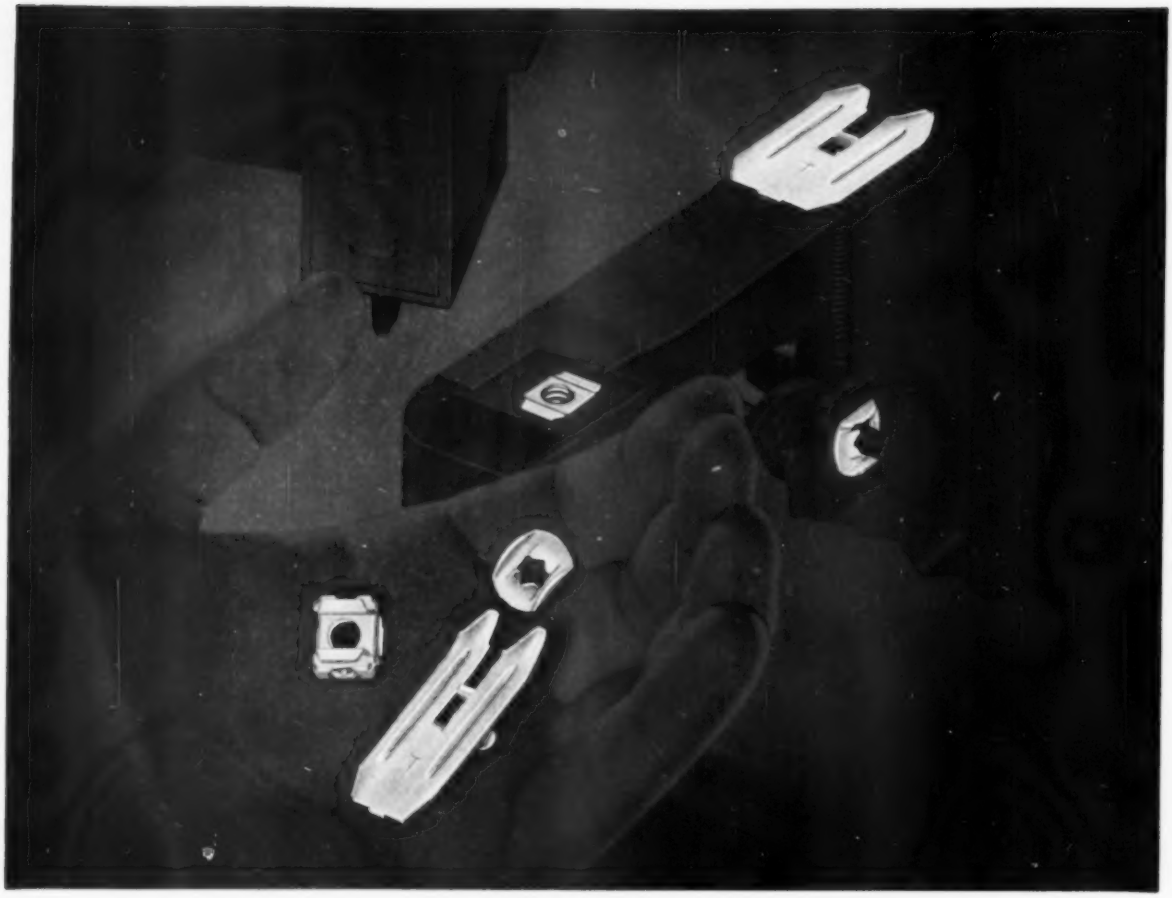
Please return coupon for your copy

AM-8

Hoover Ball and Bearing Company
5400 South State Road, Ann Arbor, Michigan

Please send new Bulletin 106, which describes Hoover pillow block ball bearings.

Name_____
Title_____
Company_____
Address_____
City_____ Zone_____ State_____



Assembly costs cut 50% at design stage by Tinnerman **SPEED NUT**® Brand Fasteners!

Fastener ideas worked out between designers at Hillside Metal Products, Inc., and Tinnerman engineers, resulted in the selection of 3 different SPEED NUT types for Hillside's complete line of quality steel office furniture. Hillside estimates "at least a 50% saving in material costs, assembly time and tooling" over ordinary fastening methods. And spring-steel SPEED NUTS hold tight, even through years of hard service.

A special Dart-Type SPEED CLIP® snaps into a punched hole, securely anchors one end of the drawer latching mechanism spring. A standard Push-On SPEED NUT "bites" into a stud; prevents the other spring end plus latching bar from backing off. Desk tops as well as desk and table legs, are attached with the help of SPEED GRIP® Nut Retainers that snap into bolt-receiving position in punched holes. A Push-On completes the file drawer follow block assembly; two more secure each filing cabinet drawer card holder.

This should give you an idea of what a free Fastening Analysis can probably do for you in savings and improvements on present or new products. Look up your Tinnerman representative in the Yellow Pages under "Fasteners". Or write to

TINNERMAN PRODUCTS, INC.
Dept. 12 • P.O. Box 6688 • Cleveland 1, Ohio

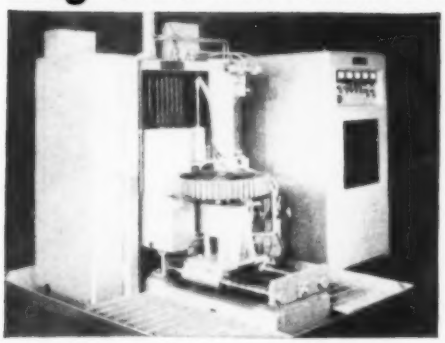
TINNERMAN
Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd. Hamilton, Ontario GREAT BRITAIN: Simmonds Aerocessories Ltd. Treforest, Wales FRANCE: Simmonds S. A. 3 rue Salomon de Rothschild, Suresnes (Seine) GERMANY: Mecano Bundy GmbH, Heidelberg.

PATTERNS FOR IMPROVED GEAR PERFORMANCE

Magnethermic Induction Scanner Heat Treats 6" to 60" Diameter Gears at... SURPRISINGLY LOW COST



Tooth by Tooth Gear Machine, a product of the Magnethermic Division

All kinds of savings with this Magnethermic method . . . low power and limited initial investment. Improved physical properties, particularly in the critical root zone, in many cases allow use of smaller gears or change-over from expensive alloy steels to plain carbon grades.

Distortion minimized with only a small part of the gear heat affected; no over-all compressive forces.

Flexibility of scanning makes inductors applicable to varying face widths, machine adaptable to many gear types, plus sprockets.

With automatic indexing, attention is confined to loading and unloading . . . cumulative positioning errors are eliminated.

These advantages have been proved in actual installations.

For estimate, quotation or engineering evaluation, send prints or outline your requirements in a letter.

Induction Heating is our ONLY Business

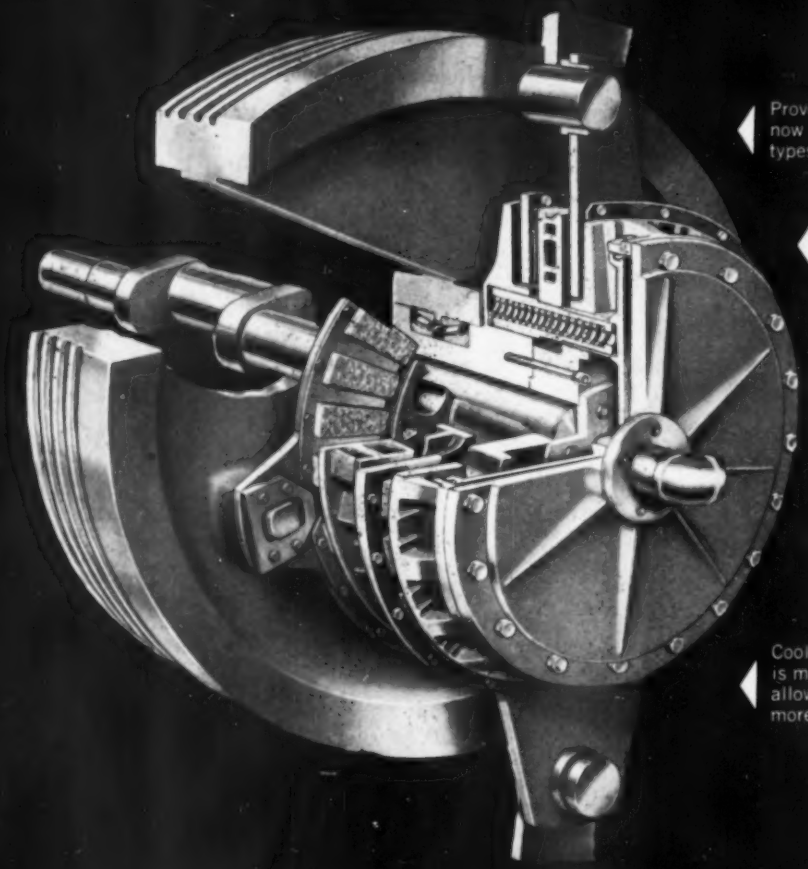
AJAX Magnethermic CORPORATION

GENERAL OFFICES

AJAX ELECTROTHERMIC DIVISION
Ajax Park
Trenton 5, New Jersey

MAGNETHERMIC DIVISION
P. O. Box 839 • 3990 Simon Road
Youngstown 1, Ohio

AJAX ENGINEERING DIVISION
P. O. Box 1418 • Lalor & Hancock Streets
Trenton 7, New Jersey



Proved design... hundreds now in daily use under all types of conditions.

Fast acting... only a fraction of inch movement between full clutch engagement and full brake.

Easy to service... with everything outside, clutch plates are easy to get at... easy to change... no disassembly required.

Self-aligning... discs "float" in mountings, align automatically. Plates also automatically compensate for wear—no adjustment needed.

Cool-running... everything is mounted on outside, allows heat to dissipate more rapidly.

New Bliss combination clutch and brake for inclinables...

RUNS COOLER UNDER TOUGH OPERATING CONDITIONS
SINGLE TRIPS FASTER... ALWAYS TOP STOPS!

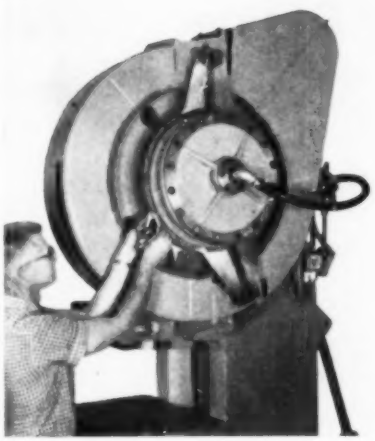
Here is a new combination clutch and brake that is rewriting the standards for inclinable press production.

It's an exceptionally fast operating clutch... one that licks the usual maintenance problems associated with high speed clutches.

Everything is mounted on the *outside*... the clutch is thus kept in open air *away* from the press frame... it dissipates heat far faster and there is no danger of bearing oil getting on the clutch plates—both factors that contribute to longer life.

An equally important feature is its universal top stopping. It practically eliminates the possibility of damaging dies through double tripping; the new CK top stops every time; ram and feeds are always in synchronization.

Bliss' new CK clutch is designed for crankshaft mounting on flywheel inclinables and main gear mounting on geared inclinable presses. In either case, it runs faster *longer*. Why not get the complete facts on this important new development today?

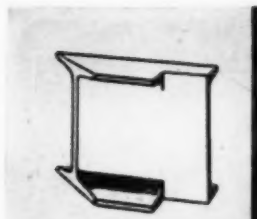


BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name—it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CONTAINER MACHINERY • CONTRACT MFG.



COPING AND MITERING HEAVY STRUCTURAL SHAPE

18" Beam (above) is held between vises for the short cut. On the long cut (left) vises were removed and beam held by simple clamp. The MARVEL Band Saw is truly indispensable in ornamental and structural iron shops where this type of work is done daily. The machine will cut-off square, miter and cope any work shape from the smallest moulding to 18" I-beams.

SPLITTING CLAMP RINGS, BUSHINGS

Splitting clamp rings, connecting rods, bushings and collets is a fast, simple operation on the No. 8 Band Saw. Perfect control, quick chucking facilities, accuracy and speed are features that especially fit the machine to handle this type of work.

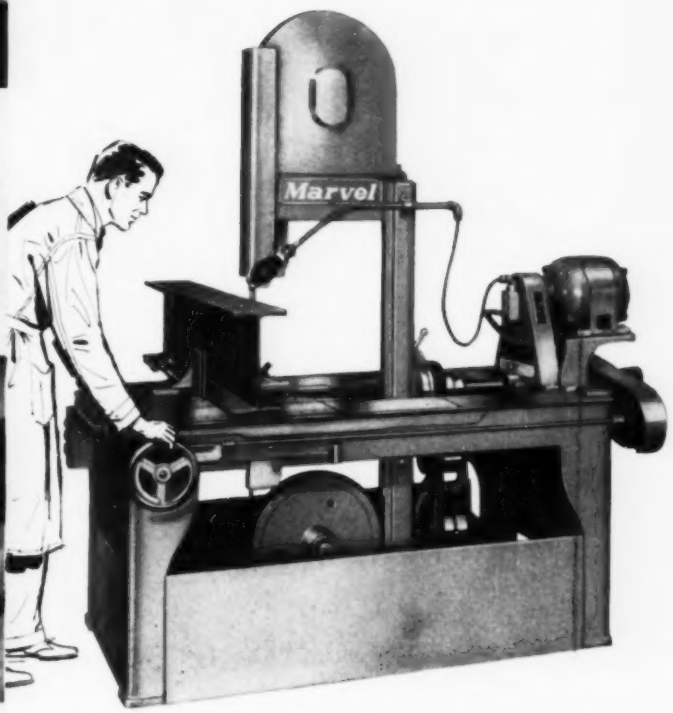
MITERING LARGE DIAMETER PIPE

Pipe (or any bar shape) may be mitered at a 45° angle without the need for special jigs or fixtures. Even when cutting miters, work remains in the same position as it does for straight cuts. Column and blade are instantly tilted to desired angle, even without stopping the machine. Perfect miters (or lesser angles) are sawed without any layout or special equipment.

SEGMENTING LARGE DIE BLOCK

Three equally spaced re-entrant cuts were made in this 16" x 18" SAE 4130 Forging. Job was completed, floor-to-floor in 5 hours. No special jigs or fixtures were required. An unusual job that serves to emphasize the versatility of the MARVEL No. 8 Saw.

"The One Machine We Couldn't Do Without"



"As simple to use and handy as a Scout Knife" is the way another user described his MARVEL No. 8 Universal Band Saw recently . . . and we can't think of a better way to describe this versatile metal cutting machine.

With a MARVEL No. 8 Band Saw, you can do almost any conceivable straight, angle, or miter metal sawing job—from cutting-off bar stock to making the most unusual forming cuts. You can handle small, delicate work, and in the next minute, saw structurals, or segment large work as illustrated in the lower photograph. You will save time, labor, and material with a MARVEL No. 8 Band Saw because no other saw has all the features to be had in this truly universal tool.

Upright column design and forward travel of the blade through the work (which remains stationary on the table-height saw bed) provides easy, unobstructed visibility and more convenient and efficient working conditions; column can be tilted and locked at any angle up to 45° left and right of vertical; the exclusive MARVEL Power Feed with Automatic Overload Relief; Automatic cutting-depth stops; simple, convenient operating controls—these are some of the features which make the No. 8 Band Saw the most useful—and used—metal cutting saw on the market.

For the complete story, ask or write for Bulletin 875 which illustrates and describes MARVEL Universal Metal Cutting Band Saws.

MARVEL *Metal Cutting* SAWS
Better Machines—Better Blades

ARMSTRONG-BLUM MFG. CO. 5700 W. BLOOMINGDALE AVE. • CHICAGO 39, ILL.

MATERIALS & FABRICATION PREVIEW

of the SOARING 60's

METAL SHOW
CHICAGO
NOV 2-6, 1959

International Amphitheatre

Project yourself into the future — prepare for the challenge of progress in metals by attending this great materials and fabrication preview of the soaring 60's! Never before so complete a program of technical sessions and informative exhibits. Don't miss it! Make plans for Chicago NOW.

EXHIBITORS! SPACE STILL AVAILABLE. WRITE OR WIRE FOR FULL INFORMATION

NATIONAL METAL CONGRESS and EXPOSITION

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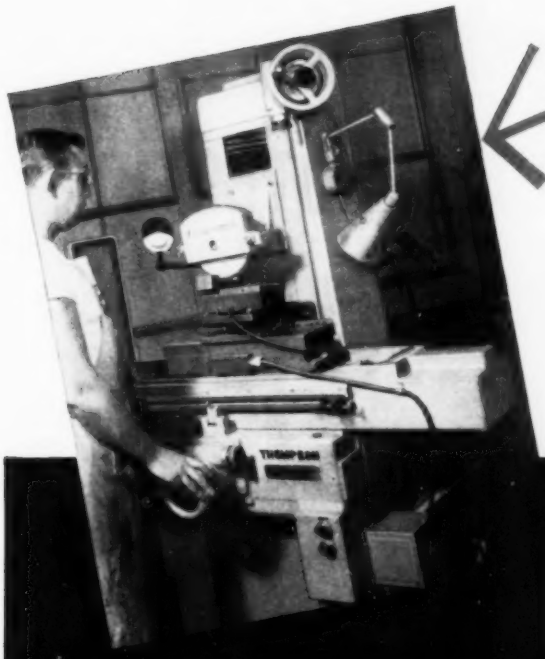
7301 Euclid Avenue • Cleveland 3, Ohio

Cooperating Activities: The Metallurgical Society of AIME; Society for Non-destructive Testing, Inc. Associations presenting technical sessions in cooperation with ASM: Metal Powder Industries Federation; Metal Treating Institute; Ultrasonic Manufacturers' Associations; Special Libraries Association—Metals Division; American Society for Testing Materials—Committee B-9; and the extensive programs of the American Society for Metals with the William Park Woodside Memorial Sessions, and ASM Metallurgical Seminars.



Completely Satisfactory in Every Way

. . . says Mr. William H. Vogt, Division Superintendent of Parts and Tool Manufacturing at Taylor Instrument Companies, Rochester, N. Y.

NEW TYPE D Hand Feed SURFACE GRINDER

is ruggedly designed for precision work.

Taylor Instrument Companies

ROCHESTER 1, N.Y., U.S.A.

May 7, 1959

Mr. John C. Wilson,
Vice-President, Sales & Engineering
The Thompson Grinder Company
Springfield, Ohio

Subject: THOMPSON Type D Surface Grinder

Dear John:

We have proven the new Thompson Type D Tool Room Grinder by rigid tests in our Tool Grinding Department. We find it completely satisfactory in every way.

We find these decided advantages on the new Thompson:

1. Its ease of adjustment
2. Its ruggedness and rigidity
3. Its bedway and column protection
4. Its large vertical capacity
5. Its cross-feed movement obtained by moving the wheel head rather than using a saddle, which permits accurate grinding of slots.

Everything considered, we find, in our work, the new Thompson Type D a very superior precision machine.

Yours very truly,

William H. Vogt

William H. Vogt
Division Superintendent
Parts and Tool Manufacturing

whv:lb

With men like Mr. Vogt, who rate tool room grinders solely on their performance, Thompson's new Type D machine is winning enthusiastic approval.

Send for descriptive literature on this new Type D machine and compare the advantages it offers you in cost-cutting time-saving and trouble-free performance. Immediate delivery is available.

"Keep Thompson in mind for that daily grind"

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO.

SPRINGFIELD, OHIO

When you buy Motor Starters--

YOU PAY FOR OVERLOAD PROTECTION

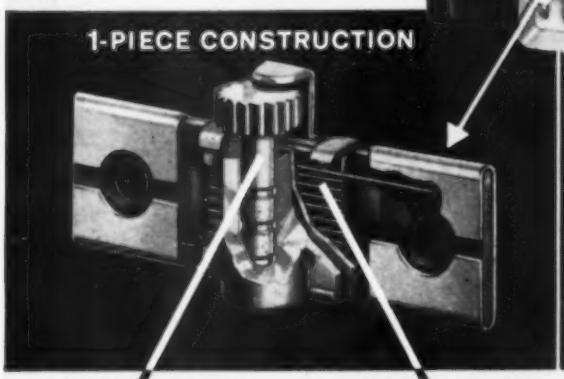
Only ONE-PIECE Overload Relays give 100% Protection • Only with ONE-PIECE construction can you *know* you've installed the heater correctly. Only with ONE-PIECE construction can you *know* the heater is exactly centered, or properly positioned, so that it performs according to its rating. Only with ONE-PIECE construction can you *know* your motors have full protection.

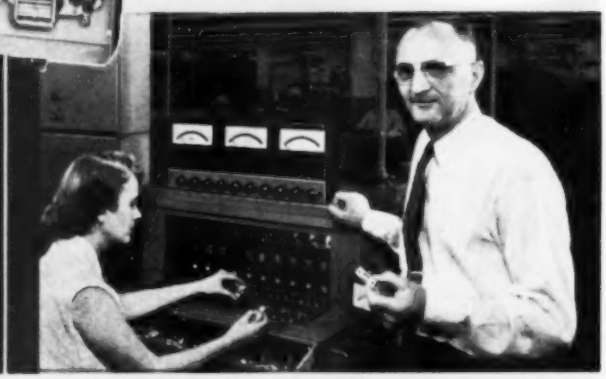
Only Square D has ONE-PIECE Construction • ONE-PIECE construction *eliminates* any possibility of heater misalignment. Square D melting alloy thermal overload relays can be installed only one way. They are tamper-proof. They are factory-assembled, are *individually* calibrated and tested. Repeated tripping will not affect accuracy.

Insist on
Square D melting alloy
thermal overload relays

***Write** for Bulletin SM-275 for the complete story on Square D starters with ONE-PIECE thermal overload relays. Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.*

...BE SURE YOU GET IT!





Heat-responsive element (solder pot) provides accurate response to overload, yet prevents nuisance tripping.

Heat-producing element is an integral part of overload unit. It's permanently joined to solder pot, can't become misaligned.

Individual factory inspection of every Square D melting alloy thermal overload relay means performance you can trust. Each unit is calibrated and thoroughly tested to make sure it will perform according to its rating.

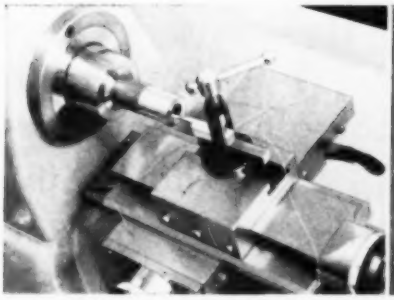
EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY

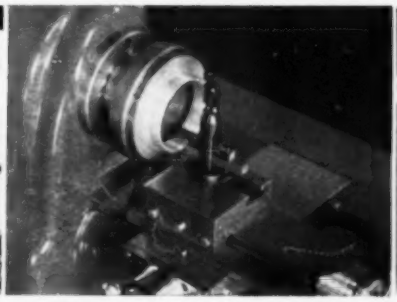
HARDINGE
ELMIRA, N.Y.

HIGH SPEED PRECISION LATHE

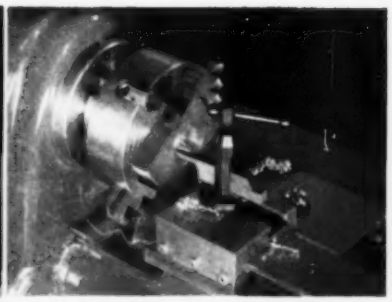
Correct Size - High Speed - Precision Results



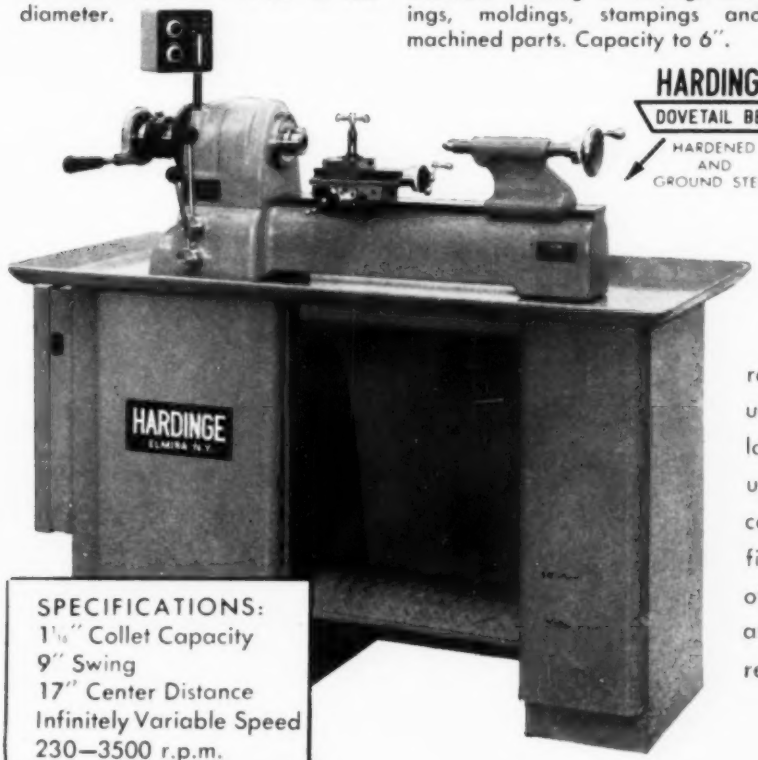
Collet Work — The right machine for collet work of 1–1/16" or less diameter.



Step Chuck Work — For rapid and accurate holding of tubing, castings, moldings, stampings and machined parts. Capacity to 6".



Jaw Chuck Work—Integral mount, universal or independent, for extra accuracy. Capacity to 5".



SPECIFICATIONS:
1 1/16" Collet Capacity
9" Swing
17" Center Distance
Infinitely Variable Speed
230—3500 r.p.m.

The above three important requirements for proper lathe work in tool rooms, production departments, or laboratories are completely fulfilled by the new Hardinge DV59 High Speed Precision Lathe.

Correct size of the machine in relation to work saves loss from under-capacity production on larger lathes. High spindle speeds, up to 3500 r.p.m., permit full capacity cutting and excellent finish. Sustained accuracy and ease of operation assure precision results

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HARDINGE BROTHERS, INC., ELMIRA, N. Y.
"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

CIRCLE 204 READER SERVICE CARD

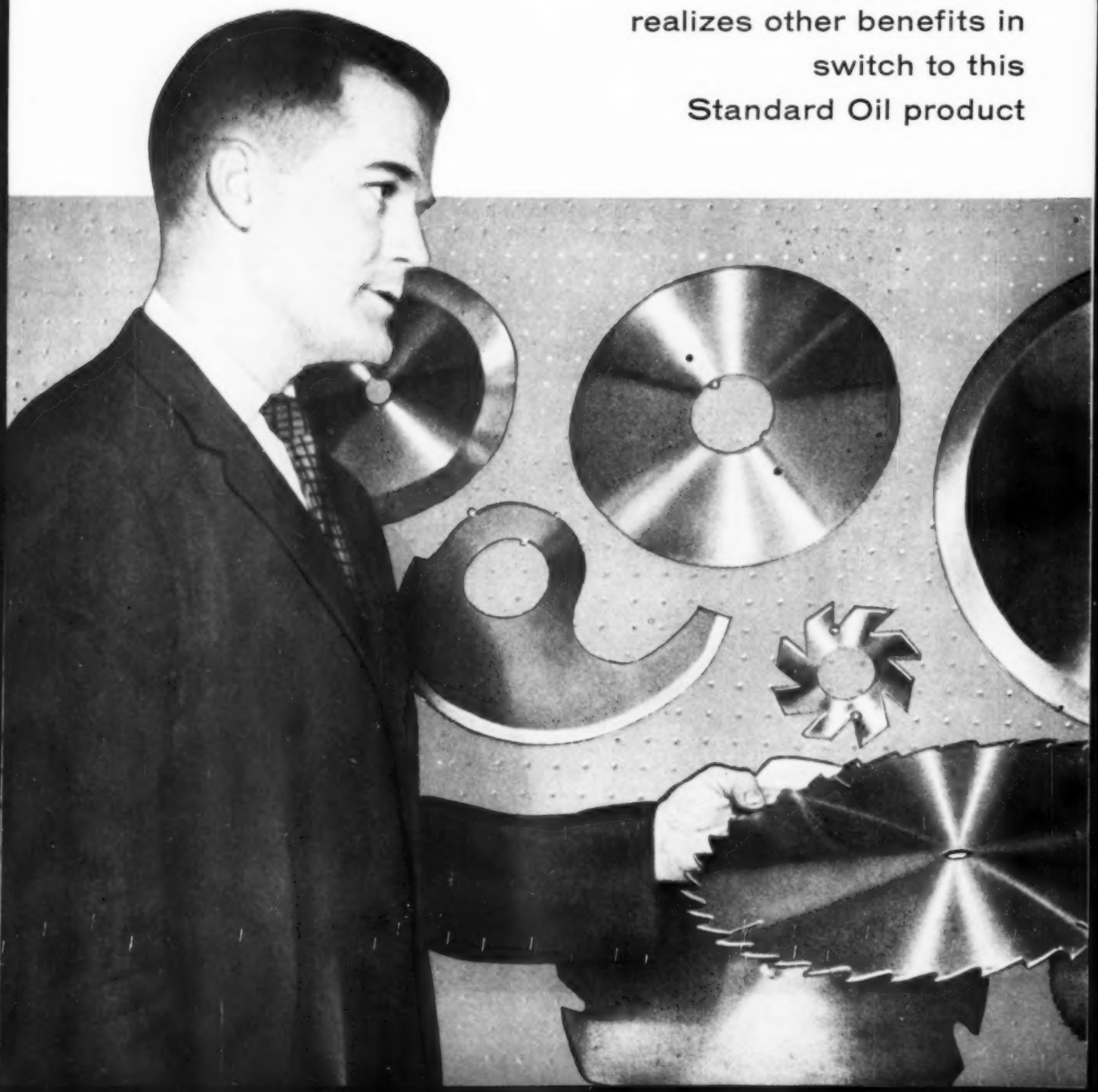
CIRCLE 205 READER SERVICE CARD ►

Gets 40% savings in coolant costs by change to

Standard's Transparent Coolant

ARGON Oil No. 4

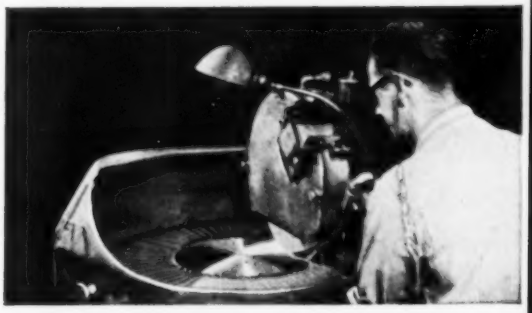
Chicago Saws, Inc., realizes other benefits in switch to this Standard Oil product



Situation: It all started when a Standard Oil lubrication specialist recommended ARGON Oil No. 4, Standard's transparent coolant to Chicago Saws for use in their grinding operations. This manufacturer of rotary saw blades decided to give it a try. They knew the product was the result of more than three years' work in Standard's research laboratory, and that it had been extensively field tested.

What happened: Using ARGON Oil No. 4 in 100:1 concentration, Chicago Saws was able to reduce coolant costs 40%. They also found the work could be seen more clearly when using this coolant. There was less wheel loading. They also discovered the coolant didn't foam and that its exceptional ability to carry off heat resulted in cooler operation. Faster cuts were obtained with finer wheels. Tolerances were easier to hold. Better finishes were obtained. Wheel dressings were less frequent.

What you can do: Get more information about ARGON Oil No. 4 transparent coolant. Call the Standard Oil lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Or write: **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.**



Using ARGON Oil No. 4, Chicago Saws gets better finish at savings of 40% over other coolants tried. Operator is using .004" cut on heat treated Rockwell 60 C steel.

You expect more from **STANDARD** *and you get it!*

Quick facts about

Standard's Transparent Coolant

ARGON Oil No. 4

- Clear, transparent fluid
- All chemical. Does not support bacteria growth
- Unaffected by humidity
- Nonfoaming
- Fire resistant
- Odorless

Standard's Bob Stark and Chicago Saws' vice president Paul Bostrom discuss blades and coolants. Bob Stark is well qualified to work with manufacturers on the use of metalworking coolants. Bob has a chemistry degree from Illinois College plus three years' experience at Standard. He has completed the Standard Oil Sales Engineering School course.

ACCURACY

When You Buy from Your Local P&W GAGE SPECIALIST

Not just an "Order-Taker," but a *specialist* trained to give you expert application engineering service, this man can help you select the best gages for your specific applications . . . from the complete lines carried in stock at your local P&W Branch Office. He will show you how you will benefit from the improved gaging precision, greater dependability and longer wear life made possible by the greater skill and care that go into the manufacture of P&W Gages.

There's a P&W Branch Office near you. Phone today, and take advantage of the convenient stocks, assured gaging dependability, and expert application engineering service that are all yours for the asking.

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BUFFALO (Tonawanda), New York
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CHARLOTTE, North Carolina
Phone EDison 2-7774
CHICAGO, Illinois
Phone HUmboldt 9-1626
CINCINNATI, Ohio
Phone PArkway 1-3112
CLEVELAND, Ohio
Phone ORchard 1-7216
DALLAS, Texas
Phone FLeetwood 2-1709
DENVER, Colorado
Phone DExter 3-4418
DETROIT, Michigan
Phone Diamond 1-1070
HOUSTON, Texas
Phone WAlnut 6-9643
JUPITER, Florida
Phone 4535

LIVINGSTON, New Jersey
Phone WYman 2-5353
LOS ANGELES, California
Phone ANgelus 3-7506
MILWAUKEE, Wisconsin
Phone GLenview 3-7650
NEW YORK CITY (Flushing), New York
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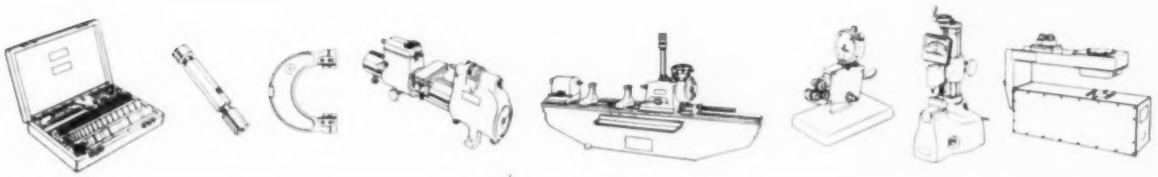
Pratt & Whitney HOKE® and USA Gage Blocks are accurate to millionths for size, flatness and parallelism. They *stay accurate longer*, because P&W gives extra care and attention to every detail of manufacture that can contribute to higher quality and better wear resistance. Remember, wherever precision measurement is concerned, the finest always costs less in the long run . . . so make your choice P&W and be *sure* of the finest!

For additional information about P&W Gage Blocks – and other gages in the complete P&W lines – consult your local Pratt & Whitney Gage Specialist. The expert gage application engineering service he provides, at no extra cost, can help you improve your precision standards and cut gaging costs. If you prefer, write direct to Pratt & Whitney Company, Inc., 11 Charter Oak Boulevard, West Hartford, Conn.



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How B&W JOB-MATCHED TUBING helps you design a better end product

You can get the right tube for your job with B&W Seamless Mechanical Tubing because you can choose from:

- ...a range of sizes, grades, and finishes for design flexibility
- ...a variety of heat treated conditions for the most suitable mechanical properties
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These are just some of the reasons it pays to specify B&W Job-Matched Mechanical Tubing. Call your local B&W District Sales Specialist, or write for Bulletin TB-361 for full information. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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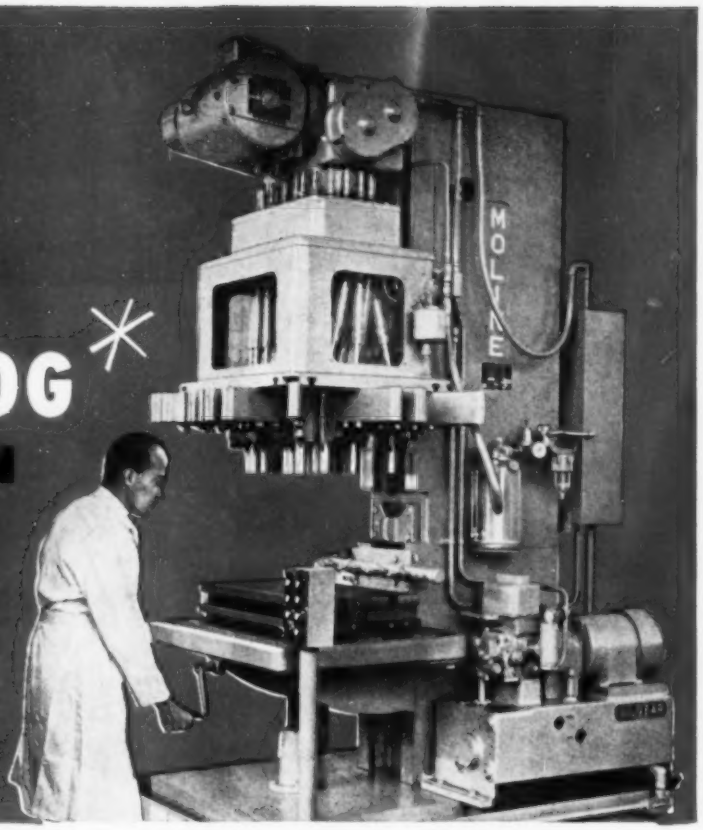
Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

THE MAGIC OF

Norgren

MICRO · FOG LUBRICATION



1 Qt. of Oil Lubricates Machine Completely for 90 HOURS

Moline Tool Co. has selected a Norgren MICRO-FOG Lubro-Control Unit to lubricate automatically 40 gears and the 24 universal joints on this Moline 24 spindle Drilling Press. Just the right amount of clean, fresh oil—½ oz. per hour—is applied to provide the most efficient lubrication, holding machine wear to a minimum.

Bearing Temperatures Reduced 10° to 20° F.

At Charlotte Pipe & Foundry, Charlotte, No. Carolina, four machines for centrifugally casting soil pipe were converted to Norgren Micro-Fog Lubrication. Results: • Saves 216 gallons of oil a week. • Ended flash fires resulting from oil leakage. • Eliminated ¾ hp pumps on oil circulating system.

Milling Accuracy Improved — Rejects Reduced

A leading automotive equipment manufacturer uses Norgren MICRO-FOG to replace grease packed lubrication method which caused machine to run so hot after one hour that the guide rods expanded, resulting in machining inaccuracies. Now . . . with Norgren MICRO-FOG Lubrication: • Heat problem has been eliminated—after 8 hours of continuous operation, the machine runs at a temperature only slightly above ambient. • Milling accuracy has been greatly improved. • The number of rejects has been substantially reduced.

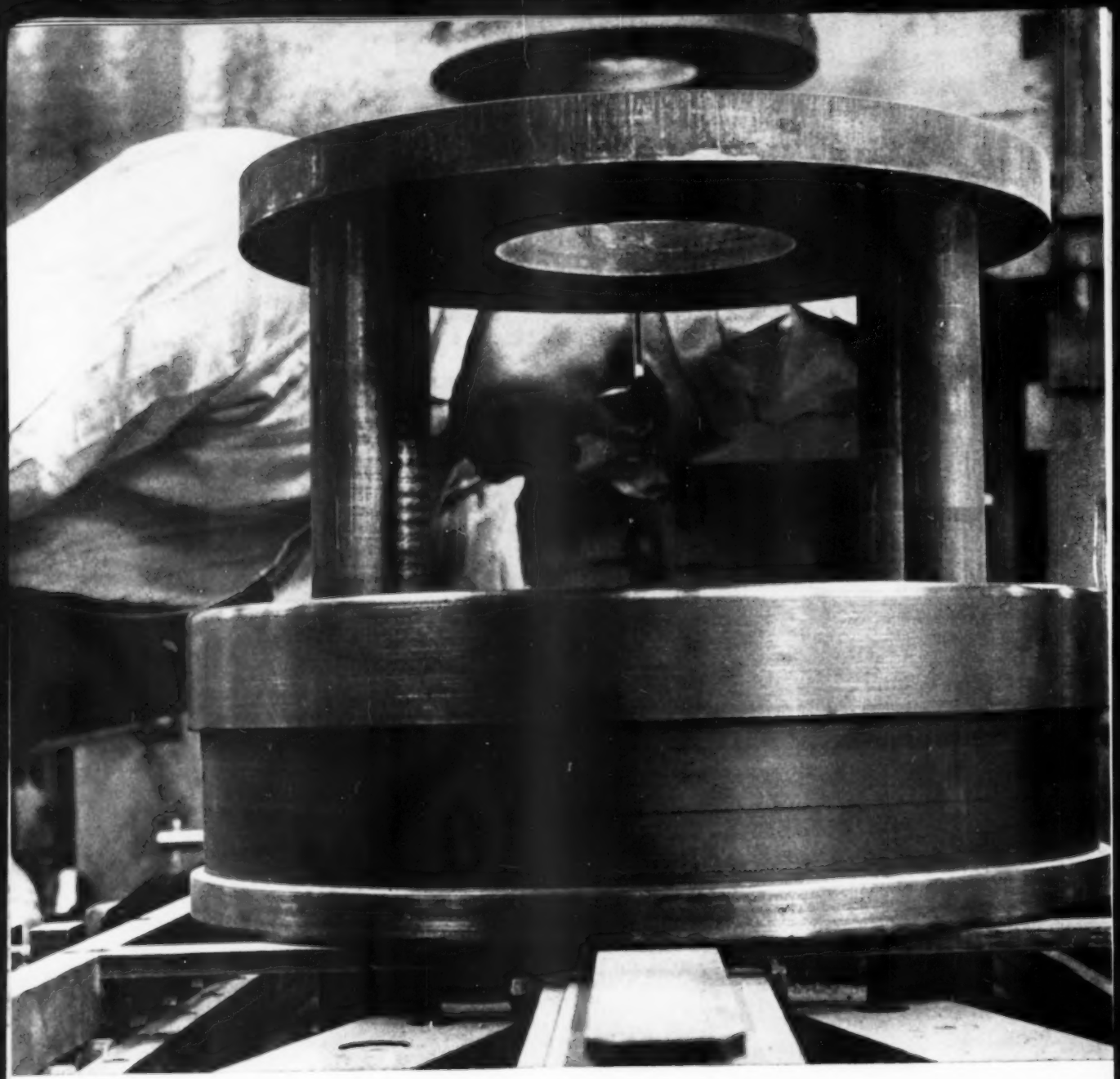
If it's Norgren...It's Dependable.

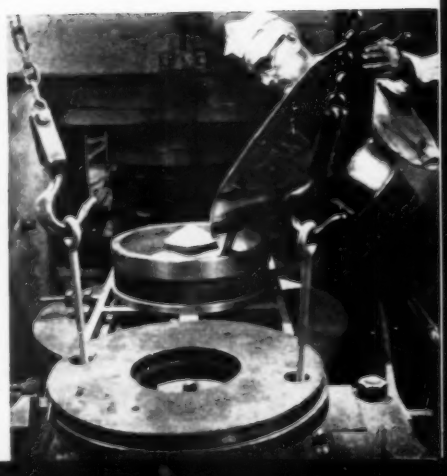
Let the MAGIC of Norgren MICRO-FOG help you—call your nearby Norgren Representative listed in your telephone directory—or

WRITE FOR DESCRIPTIVE LITERATURE

C. A. NORGREN CO.

3436 SOUTH ELATI STREET • ENGLEWOOD, COLORADO





Here's a tough old squeezer that won't wear out

The donut-shaped steel disc in the main illustration is the mold plate used in a large hydraulic press. Under 2,000 tons of pressure, it squeezes an abrasive mixture in a mold to make grinding wheels. It's a tough job, and Waltham Grinding Wheel Company had to replace these discs every few months because they wore down and became unbalanced. Replacements were expensive and they wasted production time.

Finally, Waltham tried a plate made of USS "T-1" Steel. It has been used for more than a year now, and Waltham engineers say it will last indefinitely.

"T-1" constructional alloy steel has a minimum yield strength of 100,000 psi. It is exceptionally tough and resistant to abrasion—can be furnished heat treated to a minimum hardness of 321 Brinell. Compared to carbon steel, it has four times more resistance to atmospheric corrosion. In spite of its strength and toughness, "T-1" Steel can be formed, machined and welded. And because of its strength, it can be used in lighter gages, reducing weight as much as $\frac{2}{3}$, depending on the application.

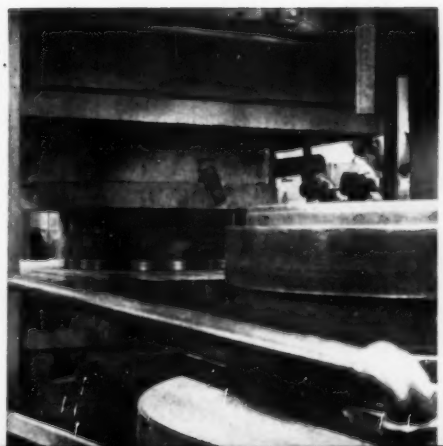
If you would like to have complete information about "T-1" Steel, write for our book "USS 'T-1' Steel," United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks

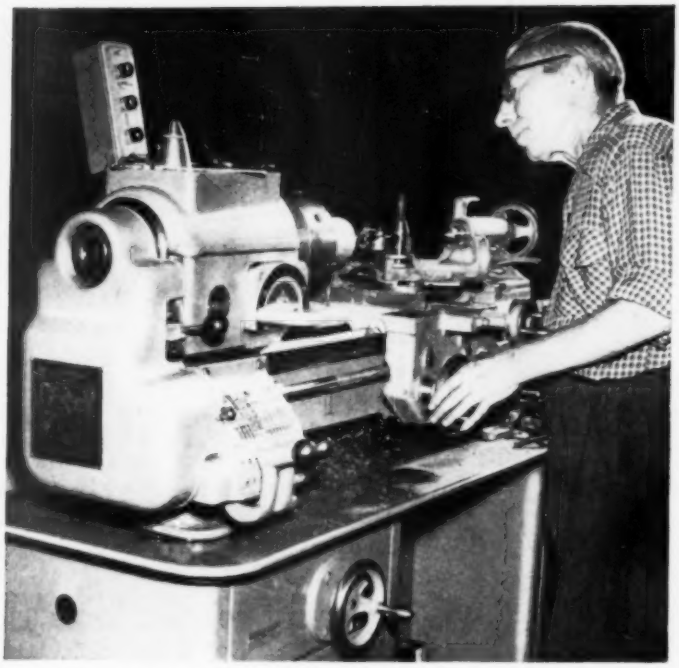
USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel



20" Drill Presses, 28 Models



11" Metal Lathes, also 10" (4' and 5' Bed)

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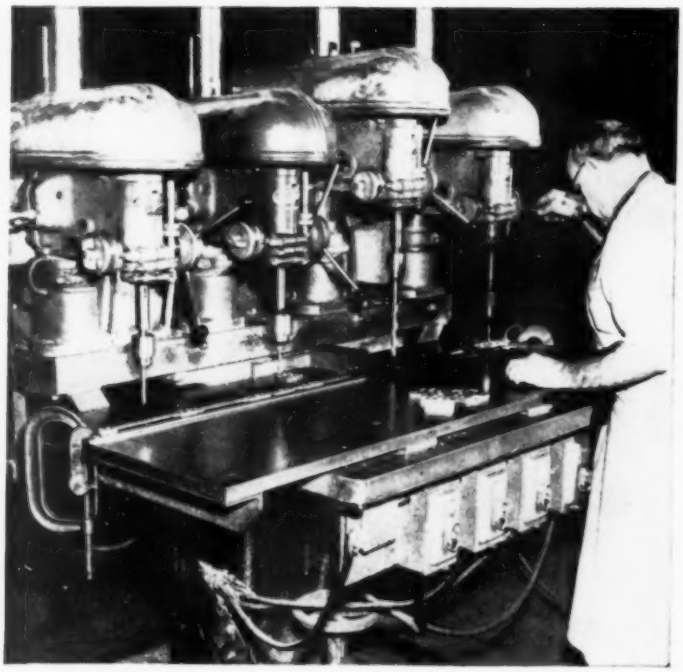
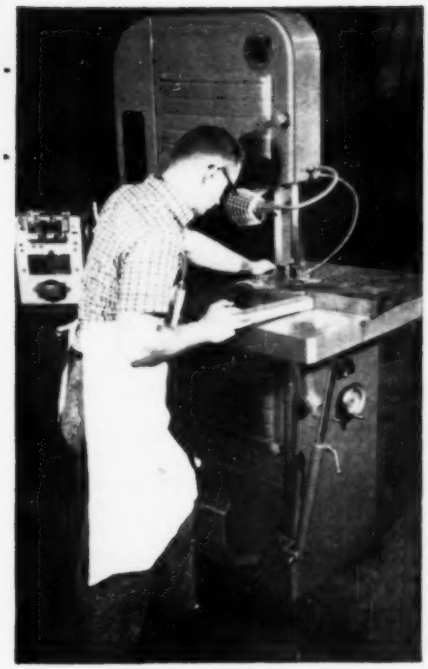
Cut-off Machines, Wet & Dry Abrasive, Non-Ferrous and Wood



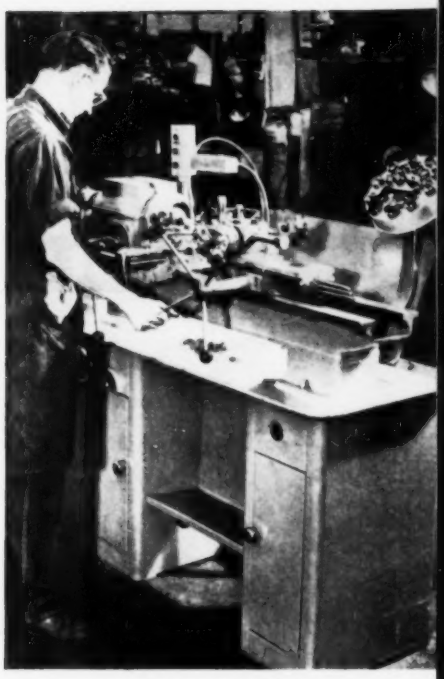
17" Drill Presses, 76 Models

CIRCLE 213 READER SERVICE CARD



20" Band Saws, also 14"

Toolmaker® Grinders, also 6" and 7"



•Hand Screw Machines

PAY THEIR OWN WAY

14" Drill Presses, also 14"
Super-Hi Sensitive and 15"

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You'll save money three ways when you put Delta Tools to work in your shop: they cost less to buy, less to operate, and less to maintain. They're ruggedly built to withstand hard wear, yet are completely mobile—offer you precision to meet the most exacting requirements.

And versatile Delta Tools can be "teamed-up" with standard automatic control devices to provide really "lo-cost" automation. Now *any* size plant can have the benefits of automation at a *fraction* of the usual investment.

Write for FREE Delta Industrial Catalog. Rockwell Manufacturing Company, Delta Power Tool Division, 618H N. Lexington Ave., Pittsburgh 8, Pa.

See Delta Industrial Tools at your nearest Delta Dealer . . . he's listed under "TOOLS" in the Yellow Pages.

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- hammers
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for fast, dependable service on all your industrial needs.

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THE CAPEWELL MFG. CO.
HARTFORD 2, CONN.

Letters...

To American Machinist
330 W 42nd St, NY 36, NY

Not a garbage grinder

Dear Sirs:
One of our clients, Wandel Machine Co, has just sent us a tear sheet on which appears a ½-page article concerning use of a "garbage grinder" at Convair (*AM*—May 18 '59, p118).

Our client appreciates the publicity given his product, but he deplores the use of the term "garbage grinder" in connection with it. It is an *Industrial Waste Disposal System*, and designating it as a garbage grinder downgrades the product considerably. There is a connotation of cheapness, poor construction, and unimportant function in this term. A precision machine which is used for the destruction of top secret documents is certainly not a "garbage grinder."

In order that you may understand the importance of the Somat machine, I am sending you with this letter a new booklet published by Wandel Machine Co. This shows the scope of jobs performed by the Somat, and its importance in an almost endless variety of industries. It may be that you will want to mention this booklet in a future issue of AMERICAN MACHINIST. Certainly if you do, you will be performing a valuable service for many of your readers.

Roy Van Hook, copy chief,
Walter S Chittick Co
Philadelphia, Penna

Straight vs tapered threads

Dear Sirs:
I read your comments on the overhaul of JIC hydraulic standards with a considerable amount of interest (*AM*—May 4 '59, p96). But I think many observers missed one of the most important actions of this session.

From the standpoint of good engineering design in hydraulic systems, a great forward stride was made by this group when the use of straight threads was adopted as a preferred means of incorporating auxiliary sealing methods in ports of hydraulic equipment. The wording as finally adopted will tend to make the tapered pipe thread somewhat less standard in future designs. The

SHOPMATES

N. Jarvis

— I WAS HOLDIN' IT JUST LIKE THIS SEE — AND THE CHUCK CAUGHT IT AND — BUT IT'S O.K. — I CAN MAKE OUT MOST OF IT — ER — SOME OF IT — MAYBE A LITTLE OF IT — UH — WHAT MATERIAL? HOW BIG?? ROUND OR SQUARE? DRILLED, REAMED OR STEAMED?? ETC — ETC!
THAT AIN'T A PRINT — THAT'S THE MASTER DRAWING — THE WHIP TOLD HIM A HUNDRED TIMES TO USE HIS HEAD ABOUT DAMAGING IT!!
TEARIN' IT UP IN A LATHE IS USIN' HIS HEAD — ANY OF US WOULDA SLOPPED ON IT TO RUIN IT!
N. JARVIS

9" column 3'-4' arms

9"-11" column 3'-4'-5' arms

13"-15"-17" column 4'-5'-6'-7' arms

19" column 6'-7'-8' arms

22"-26" column 7' to 12' arms

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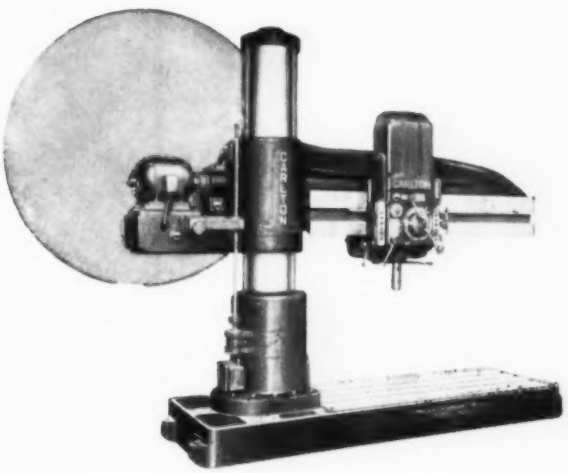
Carlton has specialized in radial drill research, engineering and manufacturing since 1916. Our close contact with—and intimate knowledge of industry's drilling requirements—have produced a wide line of the most modern and up to date radial drills. Made in arm lengths from 3-ft. to 12-ft., column diameters from 9" to 26". Programming, pre-select and manual speed-feed controls, plus special bases, tables, and jigs available for additional productivity. For further information, send today for free descriptive bulletins.
The Carlton Machine Tool Co., Cincinnati 25, Ohio.



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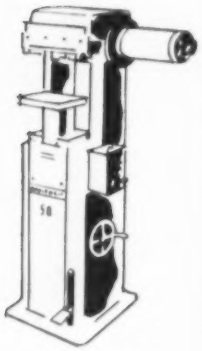
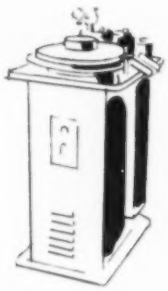
Permanent METAL MARKING

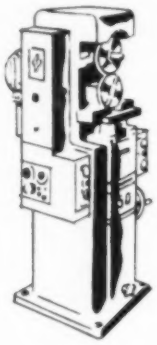
For over half a century Noblewest has been the leader in designing and building machines and tools for faster, better marking at lower production costs to users. Noblewest marking is *permanent indented marking* . . . good for the life of your product. Illustrated below are the basic types of marking equipment in the Noblewest line. It includes machines for marking, graduating, embossing and serial numbering at production speeds up to 15,000 pieces per hour with full automation. Whatever you want to *permanently* mark, it will pay you to specify NOBLEWEST. Write for comprehensive catalog. Noble & Westbrook Manufacturing Company, 17 Westbrook Street, East Hartford 8, Conn.



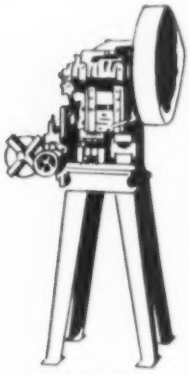
General purpose Roll-Marking Machines



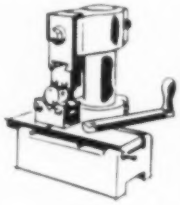
Rapid production Roll-Marking Machines



Precision Graduating Equipment



Mechanical and Pneumatic Marking Presses

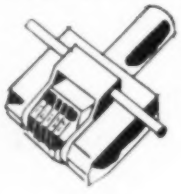


Bench Marking Machines

Precision Marking Dies

A few desirable territories open to qualified representatives.

Hand Marking Tools



Automatic Numbering Heads

MARK IT BEST WITH NOBLEWEST IMPROVED MARKING DEVICES

NOBLEWEST

ORIGINATORS OF THE ROLL MARKING PROCESS

MARKING
NUMBERING
EMBOSSING
GRADUATING

desirability of eliminating tapered threads is generally recognized by most thinking engineers, from the design standpoint.

From the standpoint of the machinist, a tapered thread is something which is almost universally abhorred, especially when we talk in terms of producing female dry seal threads. Everyone knows that it is extremely difficult to obtain good female threads of this type. One might almost say that the straight thread is the "thinking man's thread."

Z J Lansky, *chief engineer*
Hannifin Company
Des Plaines, Ill

We are glad to have Reader Lansky's views on the significance of this action—Ed.

Vacuum coating for circuits

Dears Sirs:

I was interested by an item in the "Trends" section under "Spot News" (*AM*—June 29 '59, p61).

The item was the manufacture of printed circuits by vacuum coating, using numerical-control techniques. It was stated that this was being researched by National Research Corp and other firms.

Could you supply me with the names and addresses of the people responsible for this project? I would like to contact them about the possible applications of this technique.

D G Foster
Sunnyvale, Calif

The vacuum coater (Model 3142) was developed by NRC Equipment Corp, a subsidiary of National Research Corp. NRC is located at 160 Charlemont St, Newton 61, Mass—Ed.

"That the first time you've used one of them things, Buddy?"

CALENDAR

Pressed Metal Institute—National Meeting, Sept 13-17, Stanley Hotel, Estes Park, Colo.

Society of Automotive Engineers—Farm, Construction, and Industrial Machinery Meeting and Display, Sept 14-17, Milwaukee Auditorium, Milwaukee, Wis.

American Die Casting Institute—Annual Meeting, Sept 15-17, Edgewater Beach Hotel, Chicago, Ill.

Instrument Society of America—Instrument-Automation Conference & Exhibit, Sept 21-25, Int'l Amphitheater, Chicago, Ill.

American Welding Society—National Fall Meeting, Sept 28-Oct 1, Sheraton-Cadillac Hotel, Detroit, Mich.

Society of Automotive Engineers—National Aeronautic Meeting and Display, Oct 5-10, Ambassador Hotel, Los Angeles, Calif.

American Society of Tool Engineers — Semi-annual Meeting, Oct 8-10, Chase-Park Plaza Hotel, St Louis, Mo.

American Society for Testing Materials—Pacific Area National Meeting, Oct 11-16, Sheraton Palace Hotel, San Francisco, Calif.

Magnesium Association—Annual Convention, Oct 19-20, Hotel Roosevelt, New York, NY.

American Institute of Electrical Engineers—Machine Tool Conference, Oct 19-21, Hotel Cleveland, Cleveland, Ohio.

American Machine Tool Distributors Association — Annual Meeting, Oct 25-27, Statler Hotel, St Louis, Mo.

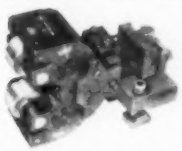
American Gear Manufacturers Association — Semi-Annual Meeting, Oct 25-28, Edgewater Beach Hotel, Chicago, Ill.

American Society for Metals—National Metal Exposition and Congress, Nov 2-6, International Amphitheater, Chicago, Ill.

National Tool & Die Manufacturers Association — Annual Convention, Nov 4-8, Statler-Hilton Hotel, New York, NY.

Reed Thread Rolling Attachments

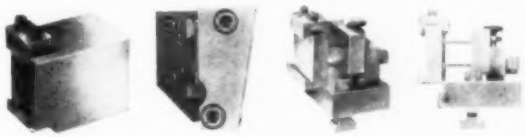
For Over 100 Different Screw Machines and Automatic Lathes



STANDARD SERIES B

Reed thread rolling attachments were developed with the assistance and cooperation of screw machine and automatic lathe manufacturers. This close association has resulted in the development of a versatile tool offering wide capacity for varied applications to meet the demands of thread and form rolling requirements.

Adapters for over 300 different cross slide applications



Special attachments designed and built for single and multi-purpose applications

Write for your copy of Thread Rolling Attachment Bulletin B-2 for helpful information on Thread and Form Rolling

REED ROLLED THREAD DIE CO.

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Specialists in Thread and Form Rolling Tools and Equipment

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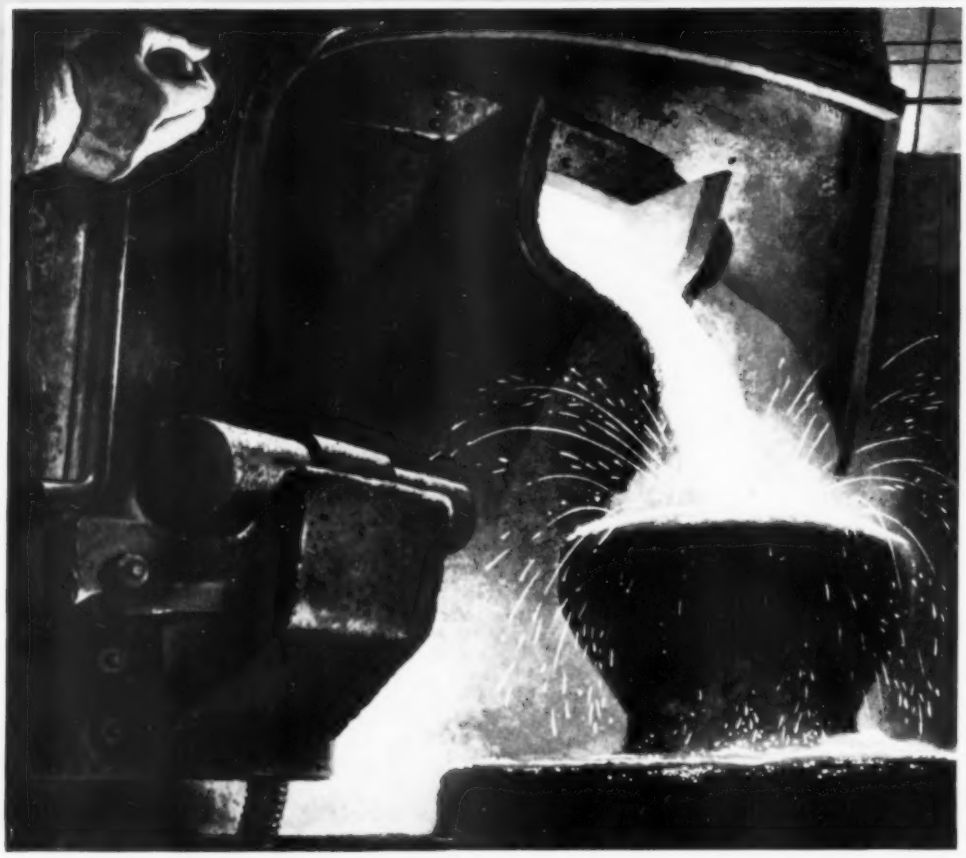


Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

Take 10 high temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus* Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.

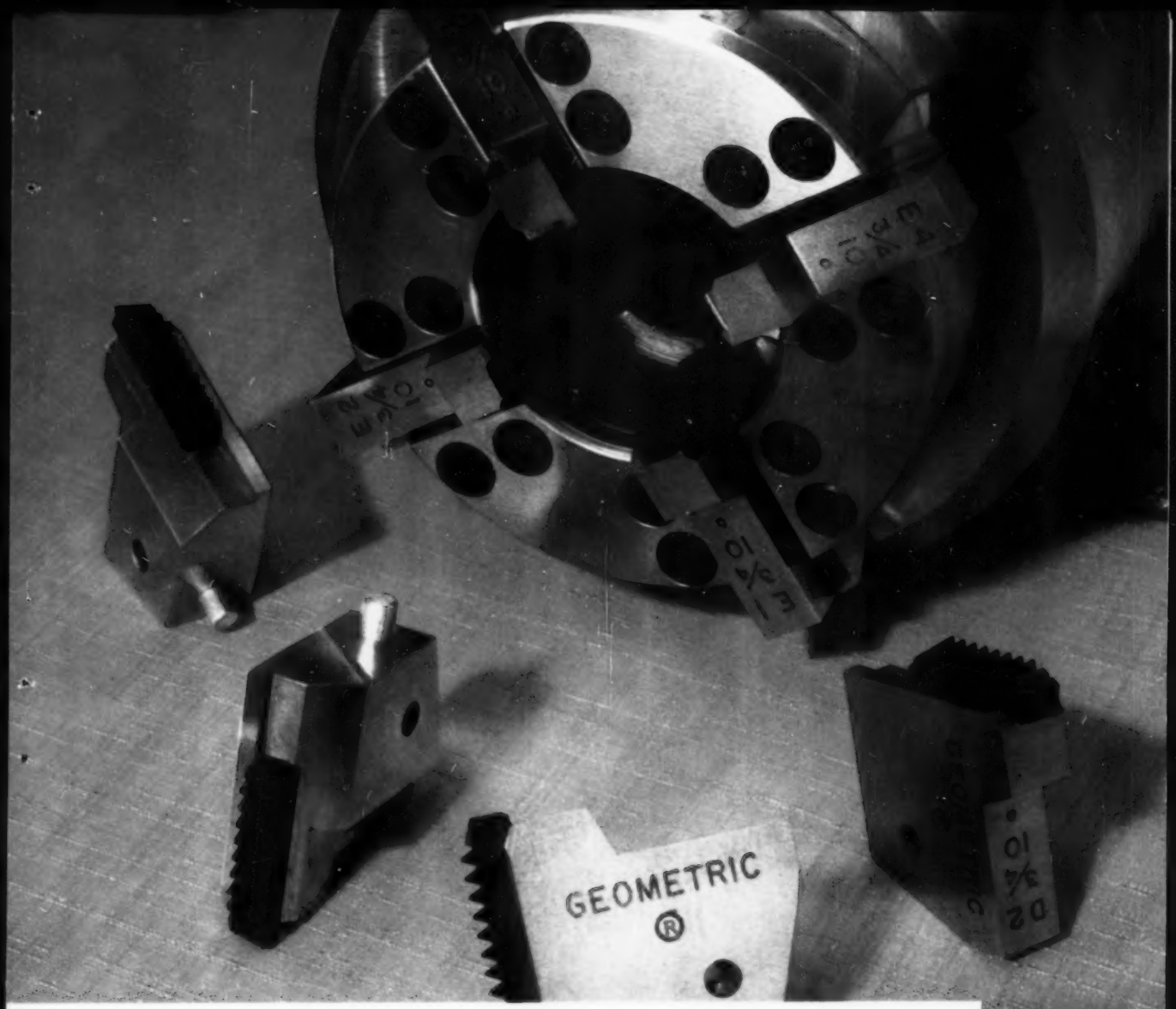
SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

SHELL

CIRCLE 219 READER SERVICE CARD

CIRCLE 220 READER SERVICE CARD ➤



INVESTIGATE...

...CARBIDE TIPPED CHASERS...FOR GEOMETRIC TOOLS

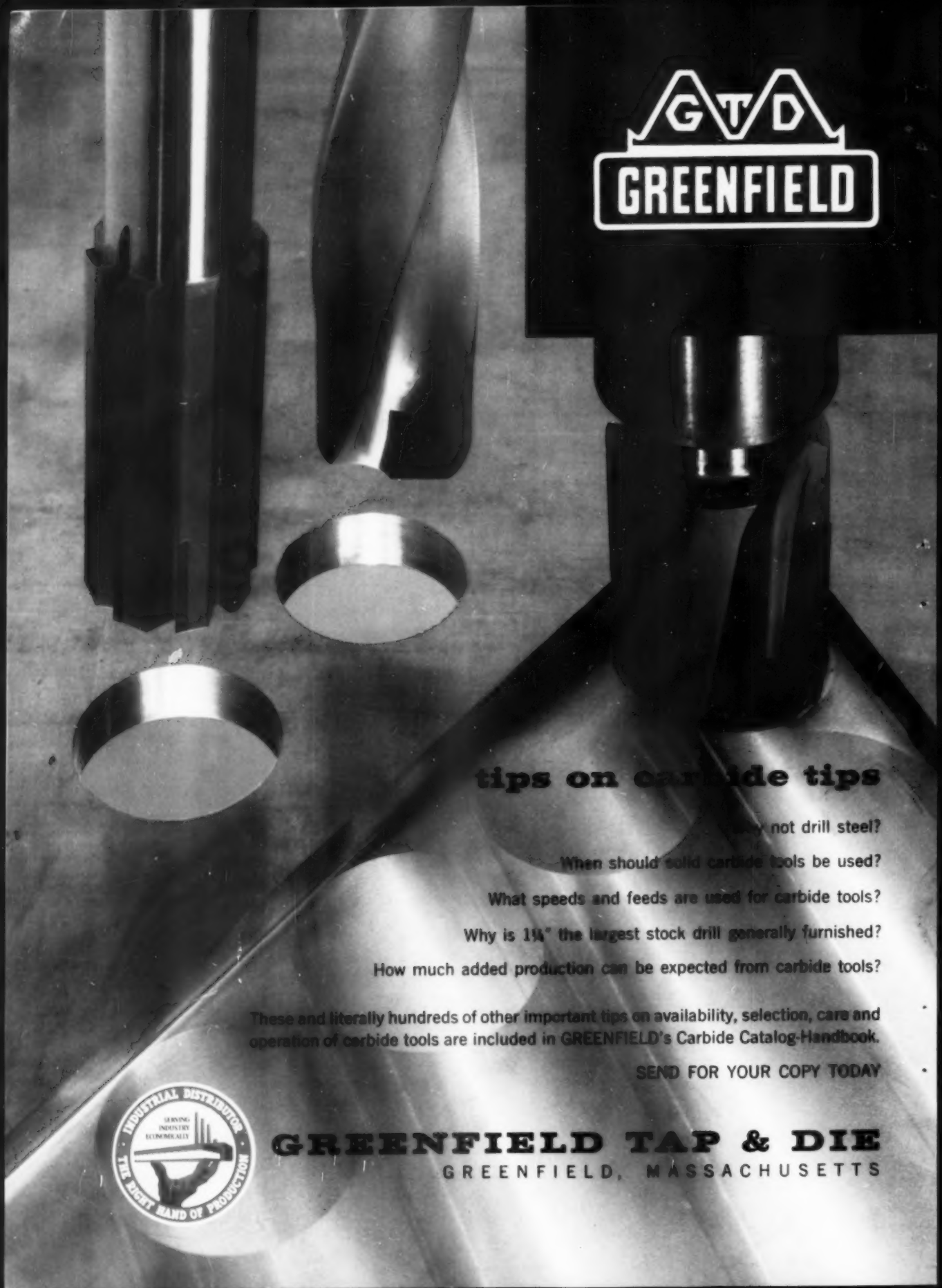
Whether you are threading stainless or heat treated steels, abrasive materials such as iron castings, malleable iron, brass, bronze, aluminum, or plastics, hard rubber, fibre and the like, ... better look into GEOMETRIC threading tools, and chasers with Carbide Inserts.

These chasers are making impressive records on high production, long run jobs where down time must be held to an absolute minimum. Parts threaded and life between grinds are multiplied over any previous method of generating external or internal screw threads.

Investigate today....write us or call your nearest GEOMETRIC DISTRIBUTOR.

GEOMETRIC-HORTON

New Haven 15, Connecticut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When should solid carbide tools be used?
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Why is 1¼" the largest stock drill generally furnished?
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INDUSTRIAL DISTRIBUTOR
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION
GREENFIELD TAP & DIE
GREENFIELD, MASSACHUSETTS

SPOT NEWS...

- **Simca of France is flying partially assembled automobiles into England** for assembly at its plant near London. Initially, the flown-in cars will have a 20% made-in-Britain content, rising to 50% in March 1960. After that, the Simcas will be completely assembled and painted there.

- **Need to educate workers in the economics of company operation** is pointed up by a survey made by a conveyor company: one out of four employees thought a profit of 25% "reasonable" (most firms average 6% after taxes); 38% had "no idea" what the company netted, 42% guessed it made more than 10% net profit; and 26% favored government price regulation.

- **Apparently the Russians are not yet familiar with Norbide** and similar materials. A recent Soviet technical article describes the use of sandblast nozzles made from iron cast around a steel chill and used without machining. Chill usually sticks in the nozzle and must be removed by an "ejecting mechanism" operated by hammer blows.

- **General Motors is announcing** (1) a new series of V-6 truck engines, ranging in size from pickups to tractors, (2) a huge 702-cu-in. V-12 truck engine, and (3) GM is expected to introduce smaller trucks later in the year with torsion-bar front suspension and coil springs.

- **Red China claims its production of machine tools has gone up 68%** since the first of the year, and output of electrical machinery 300%.

- **Nation's first "automation fund"** (to take care of workers whose jobs have been lost through automation) is being set up jointly by the International Longshoremen's Association and the Pacific Maritime Association.

- **Administration's defense appropriation** has come out of the Congressional wringer with some reshuffling of individual weapon and development projects but with the total sum close to $39.2-billion original request. This is in addition to $1.6-billion for military construction. Congress has upped military hardware procurement $325.6 million, authorized $137 for Nike-Zeus, but has cut money for the Bomarc, Nike Hercules and Mace missiles, jet cargo and trainer aircraft.

- **Air Force contract to study application** of ultra-thin-gage, high-strength materials has been awarded to Ryan Aeronautical Co, San Diego, for "a vehicle capable of operating at extremely high altitudes."

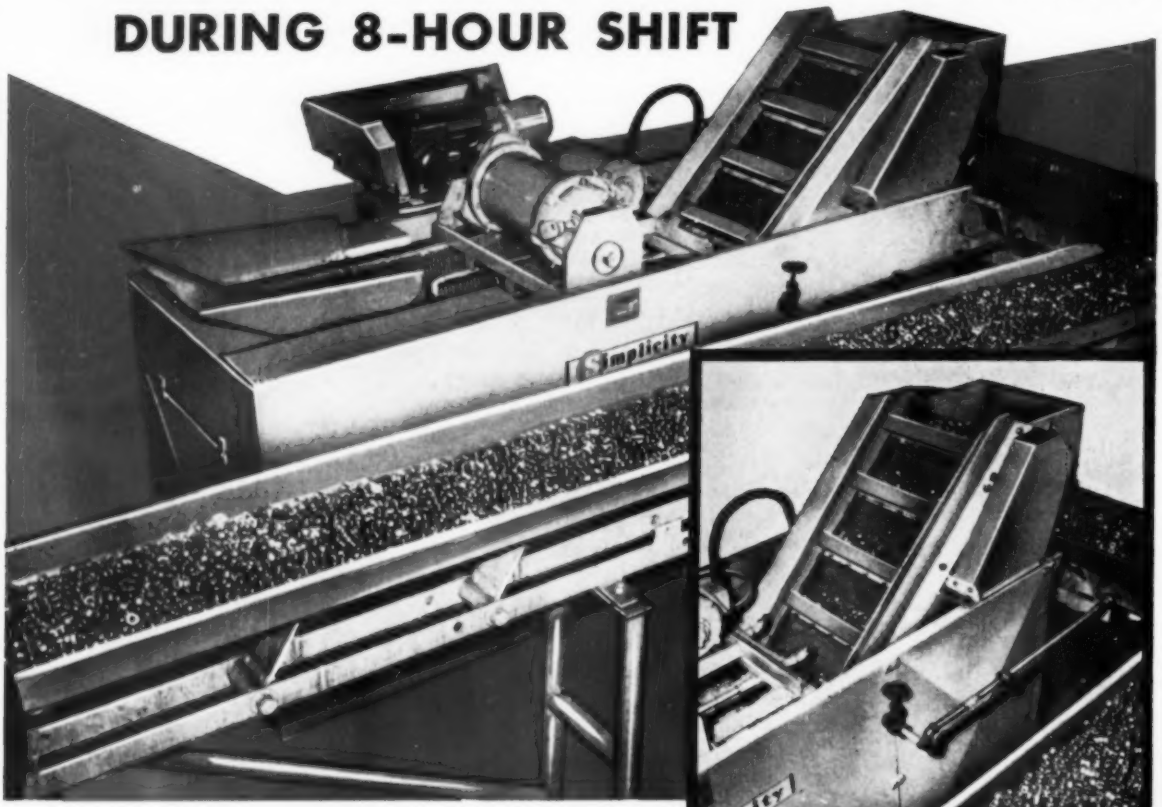
- **Production time improvements of 3600% and 2400%** are reported in machining gimbal rings for the Hawk missile. Both improvements have been achieved with a large HP 30 Lapointe horizontal broach. In one operation, simultaneous finishing on 10 ring surfaces takes 2.5 min. on the Lapointe, whereas formerly the surfaces were machined in four operations on vertical millers in 90 min. In another operation, cycle time for broaching an inside shelf and an opposed flat has been cut from 60 min, (with millers) to 2.5 min.

- **Ford is the first automaker licensed** to use U S Rubber's Marvibond process for bonding vinyl plastic to metal (a finishing process). Metal can be machined and welded in almost any way without damaging finish. Ford will use the process mainly for auto interiors.

- **Pullman Standard** (R R car manufacturer) has told the Alabama legislature that it will be forced to close if a proposed 2.5% sales tax is placed on its output—somewhere between $250 and $500 per car. Said a spokesman, "Our Alabama plant competes with plants in nine states, none of which have a sales tax, and any competitor could outbid us." If the plant closes, 1700 people would lose their jobs.

SIMPLICITY VIBRA-WASHER

CLEANS 40 TONS OF MULTI-SIZE NUTS DURING 8-HOUR SHIFT



Close view of Vibra-Washer flight conveyor and Model 36 conveyors, showing the high production capacities characteristic of all Simplicity equipment.

Decker Nut Manufacturing Corp., Albion, Michigan, is cleaning almost 40 tons of multi-size nuts (standard hexagon nuts, clinch nuts, weld nuts, pipe plugs, etc.) per 8-hour shift with the versatile Simplicity Vibra-Washer. A constant flow of nuts is fed into the Vibra-Washer vibrating assembly where, after continuous and thorough agitation in an oleum solution, the nuts are automatically elevated, contamination-free, by the flight conveyor onto a series of Simplicity Model 36 Conveyors. Here the nuts are partially dried and just the right amount of the cleaning solution is maintained for sufficient rust protection, thus eliminating an added operation. Nuts are then weighed, packaged and ready for shipment. These nuts range in size from ¼" to 1". The Vibra-Washer, however, can handle most parts up to 6 inches in size. Cleaning costs have dropped sharply at Decker Nut Manufacturing Corp. since the installation of the one-man-operated Simplicity Vibra-Washer.

For all parts conditioning jobs, the Simplicity Vibra-Washer offers many advantages. This labor-saving washer is versatile and adaptable to many operations. It involves no loading or unloading of work baskets and is available for single- or multi-stage washing operations and parts conditioning jobs and has an adjustable capacity up to 10,000 pounds per hour. The Vibra-Washer can be equipped with gas, steam or electric immersion heating elements for cleaning operations that require heated solutions. For complete details on the new Simplicity Vibra-Washer, write today for Bulletin 107.

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218

WASHINGTON...

More Pentagon economy...

The Defense Dept is once more under a serious budget squeeze. The likely upshot: a series of cuts or cancellations in major projects to develop new military hardware.

Behind the latest economy push is the Eisenhower administration's determination to mark its last year in office with a whopping federal budget surplus.

For the Pentagon as a whole this has resulted in an order not to boost total expenditures in fiscal 1961 starting next July 1 (preparation of the new budget is getting under way), and to plan spending at this year's $41-billion level.

As major development projects shape up now, increased spending next year appears inevitable. Projects such as the Air Force's B-70, F-108, and Dyna-Soar have reached the crucial stage where massive hikes in funds are required to advance from the design phase to early fabrication of hardware. Several Army, Navy, and ARPA programs are in a similar spot.

To bring them all along under current development schedules would mean a significant defense budget boost next year. But the Pentagon's aim is to hold total spending at a stable level. So the outlook is for sweeping slashes in weapon development plans.

As some Pentagon budget officials see it, the latest military economy pinch puts the kibosh on the Johns Hopkins recommendation to modernize the Army's production base (*AM*, July 27 '59).

New trend in weapon contracts...

The Congressional uproar over weapon system contracting is having the expected impact: the Air Force is taking back a few of the reins on major weapon development projects. Congressional criticism has centered on the charge that Air Force contracting officers have "abdicated" control over big projects to weapon system prime contractors.

Now the Air Force is changing policy, is trimming some of the powers of the weapon system primes as a means of spurring competition. Among the new moves: (1) freezing design configurations and contracting directly with subsystem producers, (2) "breaking out" standard items such as compressors, motors, generators, and the like from a weapon system project for open competitive bidding when volume production of the end-item is authorized, and (3) conducting separate design competitions for major subsystems.

Example on "ALBM" guidance...

The most remarkable case in which the Air Force's new de-emphasis of a prime's authority shows up is the WS-138 A, the air-launched ballistic missile (ALBM). Douglas Aircraft, which bid for the development contract with a team of other companies, won the prime contract.

General Electric was Douglas's bid partner for the guidance subsystem. But the Air Force turned down GE as the guidance subcontractor in the first go-around when Douglas landed the prime contract, has ordered Douglas to conduct open competition on the guidance subsystem.

Most backward depreciation?

U S depreciation laws "are the most backward and growth impeding in the world," businessmen told a recent Senate hearing, adding that American business should be spending $4 to $6 billion more a year for capital equipment, but can't because of obsolete depreciation allowances.

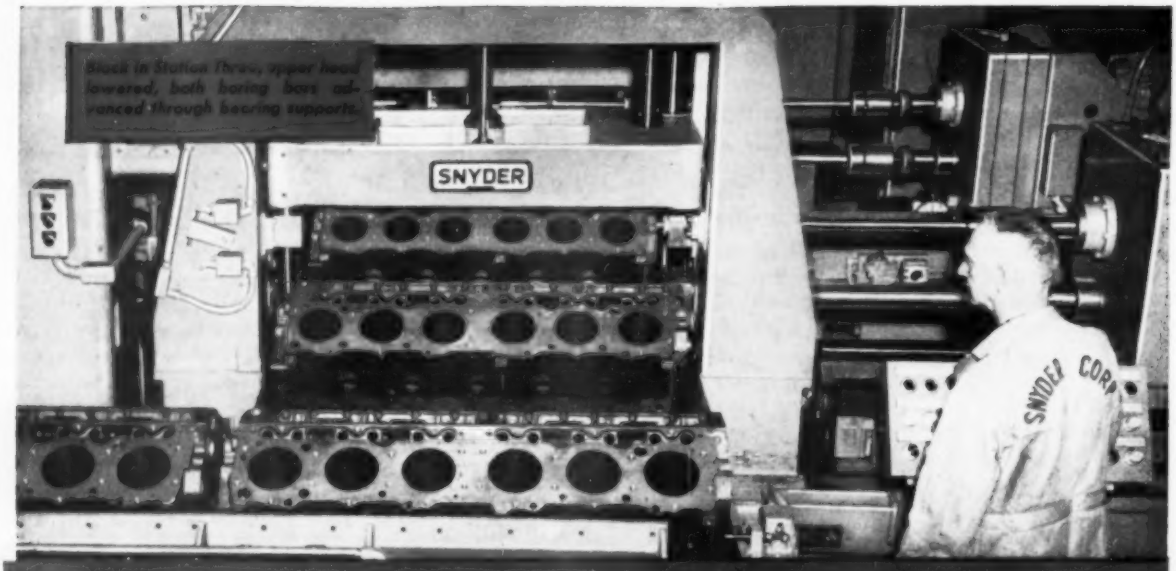
A Johns Hopkins University study, said Washington attorney Joel Barlow, concludes that machine tools should be written off in 6 to 10 years instead of the current 15 to 20 years. "It's not durability of machine tools but obsolescence we have to worry about," he said.

Not only that, Barlow added, the only way the U S can compete with cheap foreign labor is through modern equipment—yet even the foreign countries with cheap labor have far more modern depreciation rates than ours. And that's one reason why, according to Barlow, Germany's machine tool industry is bigger than ours, even though it had to start from scratch after WW II.

Barlow said he believes industry is willing to forego capital gains benefits on equipment depreciation in favor of better allowances.

Tax loss from more liberal depreciation allowances would be nil, New York CPA Maurice E Peloubet testified—for each $100 spent on machinery, $26 in direct tax revenue would be generated immediately in labor, materials, profits.

Recommended by testifying industry representatives: reinvestment depreciation (a machine which cost $100,000 10 years ago and which would cost double that to replace today, would be allowed an extra $100,000 allowance at time of replacement): and the bracket method (an upper bracket in depreciation beyond which a company would have to assume the burden of proof, and a lower bracket beyond which a company could not go—this would avoid a temptation to juggle the tax books in bad years).



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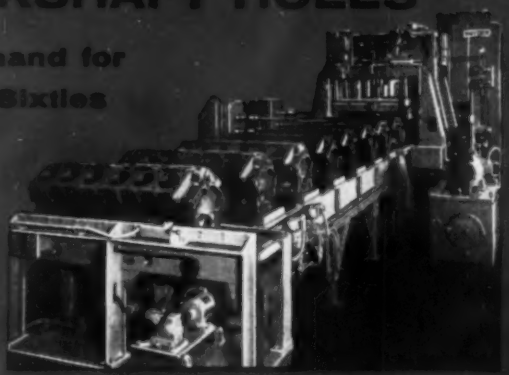
In regular production at a rate of 31 pieces per hour, main and camshaft bearing holes are rough and semi-finish bored simultaneously with all diameters held to manufacturers' specifications for alignment, roundness and concentricity. The distributor hole is also semi-finish bored in this machine to establish proper location to cam and crank bores.

Advanced engineering, both in product and production machines, is the best possible preparation for the competition of the next decade. We'll be happy to show you, too, how to SNYDERIZE for the Soaring Sixties to gain more efficient parts handling, gaging, assembly and machining. Write or phone for new brochure on machines for profit improvement.



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TRENDS

DETROIT...

Race is on...

1960 is shaping up as *the* year of big changes, to the point where automakers are dropping their two-year-old cocoon of pessimism. That veteran predictor, Ford economist George P Hitchings, has already gone on record with a sales forecast of 6.8-million units including imports, and there are those who think that he is about 5% conservative.

The three forthcoming small cars are an important part of this picture, but by no means all of it. Each of the Big Three has poured additional hundreds millions of dollars into the drastic styling and structural changes of what are now called their big cars. The independents are adding extra body styles to their fast-selling lines, and American Motors in particular has come up with a more radical than usual facelift of the Rambler.

Each company is presently jockeying for exclusive introduction dates, a highly secret but nonetheless ludicrous yearly flap that could easily be eliminated if each would draw straws. As it now stands, new cars will start appearing in showrooms by mid-September and will all have bowed by October 25.

Chevrolet's Corvair, Ford's Falcon and Chrysler's Valiant, as readers of this column have known since February 24, 1958, are all-new in their entirety. They will cost approximately 75¢ for each of their 2500 lbs, stripped of accessories.

Only available extras will be an automatic transmission, radio, heater, and deluxe trim. Even the latter option barely negates an impression of healthy austerity. There is a good reason for this. Market research shows that doctors, lawyers, engineers and other professional and white-collar people will be the most likely buyers. The average man-in-overalls still wants fancy used Buicks, or, if he can, accessory-laden Impalas, Galaxies and Fury's.

Basic and approximate specifications applying to all include: 108-in. wheelbase with a 40-in. overhang beyond either axle; about 90-hp for an 85 mph top speed and 25 mph cruising economy; nearly as much interior and luggage room as the low-priced cars of two years ago; slightly choppy but still comfortable ride; do-it-yourself service accessibility; and styling slicker and cleaner than their larger cousins.

Those who have seen the 51-in. high Corvair are unanimous in pinning on it the tag of "revolutionary." Chevrolet spokesmen, oddly enough, like to compare its expected impact to that of Ford's Model A. All pictures that have so far appeared are phoney in the sense that models allowed off the proving grounds have been "cobbled" jobs, hand-made before styling was finalized. Chevrolet firmly expects to sell 350,000 of these during the first year.

Ford's Falcon is a straightforward yet very modern affair, to be available in two- and four-door body styles with a wagon to follow. Interior trim and room is the best of the three. A 5-ft, 5-in. mechanic could lean over one front fender and readily service accessories on the opposite side of the miniaturized, OHV-six engine.

Chrysler Corp's Valiant is the most European in flavor. Its low hood forced angling the new OHV six on its right side by about 30°. A new but simplified three-speed automatic will be an option. Valiant will be the last to have cars on sale, but may be the first with a station wagon.

Other 1960 models have grown even bigger, but not by the leaps and bounds of past years. Biggest mechanical news, in passenger cars at least, is Chrysler Corp's new unitized body, used by each of its makes except Imperial. This is a straightforward design, reminiscent of past "forward look" cars, that features a unique stub frame in front to firmly anchor the torsion-bar.

Six-cylinder versions of the Plymouth, Darts and Dodges offer a bored-out version of the same inclined engine used on the Valiant. Later in the year, some Chrysler makes will catalog optional V-8's with "Ram-Air" injection. No relation to fuel injection, this fuel-air distribution system involves two carburetors, mounted on both sides of the engine, that feed into long crosspipes. Benefit is said to be most pronounced in passing speed ranges.

Ford and Edsel, which share a common body shell, have been completely reworked—although engines and chassis remain fundamentally the same. The Edsel with its knife-edge fenders, Pontiac-like grill and sloping "A" post is one of the most beautiful cars to come down the turnpike in a decade. Mercury retains its old shell, but the lines have been considerably softened. Lincoln and Thunderbird have been little changed.

General Motors has given each of its makes a massive facelift. All share last year's fundamental cowl structure with its 1760-sq-in. windshield. Pontiac for inexplicable reasons has dropped its beautiful jet nose in favor of an orthodox grill with horizontal bars. Buick has inexplicably restored its ventaports and otherwise heavied up its basically slick lines. Chevrolet has sharp b·eak poin·ts, less angle in its gullwing rear.

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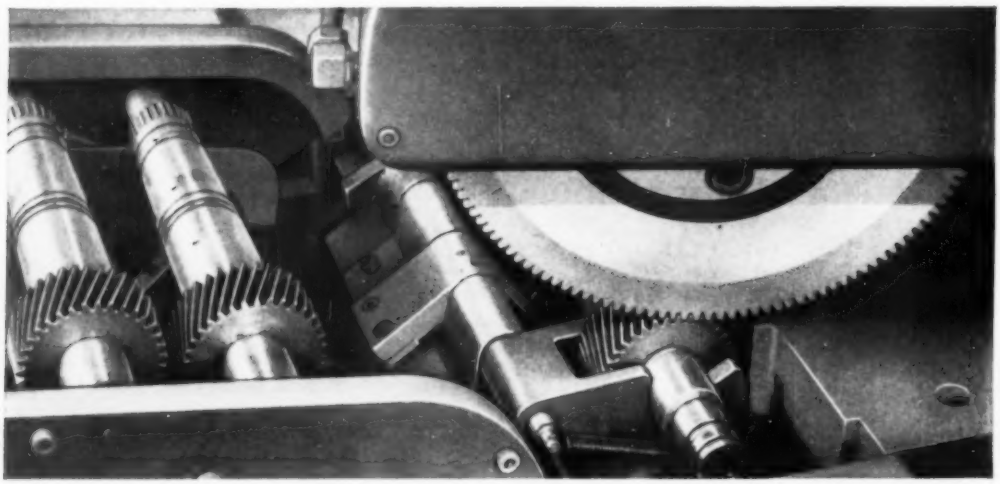

USERS

- The aircraft industry
- The automotive industry
- Computing machine manufacturers
- Motorcycle industry
- Tractor industry
- Gear manufacturers
- Electric motor (gear head) industry
- Machine tool builders

GEARS BEING HONED

- Transmission gears
- Timing gears
- Change gears
- Computor gears
- Main drive gears
- Motorcycle gears

PURPOSE OF HONING

- To remove nicks and burrs
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- To improve noisy gears
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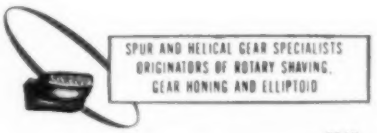
For complete details on Hard Gear Honing, write for Bulletin H-57-2.



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WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

AIRCRAFT and MISSILES...

TRENDS

New budget double check...

Congress has clamped a double check on military procurement of aircraft and missiles. The new measure requires the Armed Services Committees of both Houses to okay an "authorization" bill in addition to the money bills taken up by the two Appropriations Committees. This sort of double Congressional check is now routine for foreign aid and military construction spending.

The new requirement reflects Congress' intent to stress its role in military policy making. You've already seen signs of the trend in recent Congressional action on the Nike-Hercules-Bomarc missile squabble.

The Congressional double check on the procurement budget for aircraft and missiles will make military hardware shopping lists even more unsettled than they are now. On long-range planning for production runs, contractors in these fields will have still another obstacle to sweat out before drawing Pentagon funds.

Actually, the new measure is a compromise. The Senate wanted the double-review to cover research and development spending for planes and missiles, in addition to procurement. The House was opposed to the measure in general.

Dyna-Soar decision in 60 days...

The Pentagon expects to select the winning design team on the Dyna-Soar boost-glider or orbital bomber within 60 days. Two teams of contractors are competing on design studies. One team, headed by Martin, includes Bendix Aviation (communications), Goodyear Aircraft (crew escape capsule), Minneapolis-Honeywell (guidance and navigation systems), and American Machine & Foundry Co (gantry and launching pad).

The other team, headed by Boeing as weapon system contractor, consists of GE, Thompson Ramo Wooldridge, North American Aviation, Chance Vought, and Aerojet-General. Dyna-Soar will be a piloted space craft, launched to an altitude of about 100 miles by a multistage rocket booster producing some 335,000 lbs of thrust (either the Atlas or Titan ICBM modified), then blasted along its own trajectory by a 75,000-lb-thrust engine of its own.

The Air Force's new downgrading of weapon system primes' powers (see p75) places a new cloud over the subcontract prospects of the Boeing and Martin bid partners. The project also faces an intense Pentagon review under the latest Defense Dept economy drive before it is allowed to advance to a later stage of development.

No crash program on A-plane...

First open Congressional hearing on the off-again, on-again nuclear aircraft project demonstrated the administration's intent to stick by its decision postponing construction of a prototype plane until development of the propulsion system is perfected.

There's still no target date for first flight of the aircraft, and officials say this will not be achieved until some five years after such a date is set.

One major change in the program is shaping up. The Defense Dept and AEC plan to speed up work on Pratt & Whitney's indirect-cycle propulsion system. P&W is one of two contractors on propulsion. The other is GE, which is working on a direct cycle reactor that provides direct heat to a turbojet engine—as distinguished from the indirect cycle, which transfers heat through a liquid metal.

The Navy, which wants to tie an indirect-cycle nuclear reactor to a turboprop-powered seaplane, has awarded Martin a new contract to study airframe design.

Growing pains at Convair...

With employment at Convair's Astronautics Division hurdling the 10,000 mark, Convair has had two major problems to solve: (1) Pre-assignment indoctrination and training for newly hired engineering graduates, and (2) finding a spot to do such training in a filled-to-capacity plant.

In answer, Convair has come up with "Project Aztec," which provides a solution to both problems. Now, incoming engineering graduates undergo a four-week course in groups of 20 (current indoctrination class has 180 engineers), divide their training time between the Astronautics plant and San Diego State College, where they have been assigned five lecture and two drafting rooms.

Initially, the "students" spend eight hours a day in class at San Diego State College, then spend four hours a day for the last eight days of their course at the Astro plant.

Five engineers act as instructors, are aided by 40 "guest lecturers" as they take the new engineers through the entire Astro plant, following a hypothetical ballistic missile project. Here they cover predesign, development, fabrication, test and final delivery.

The new plan has already paid off in better orientation and in actual dollar savings in training, Convair officials say.

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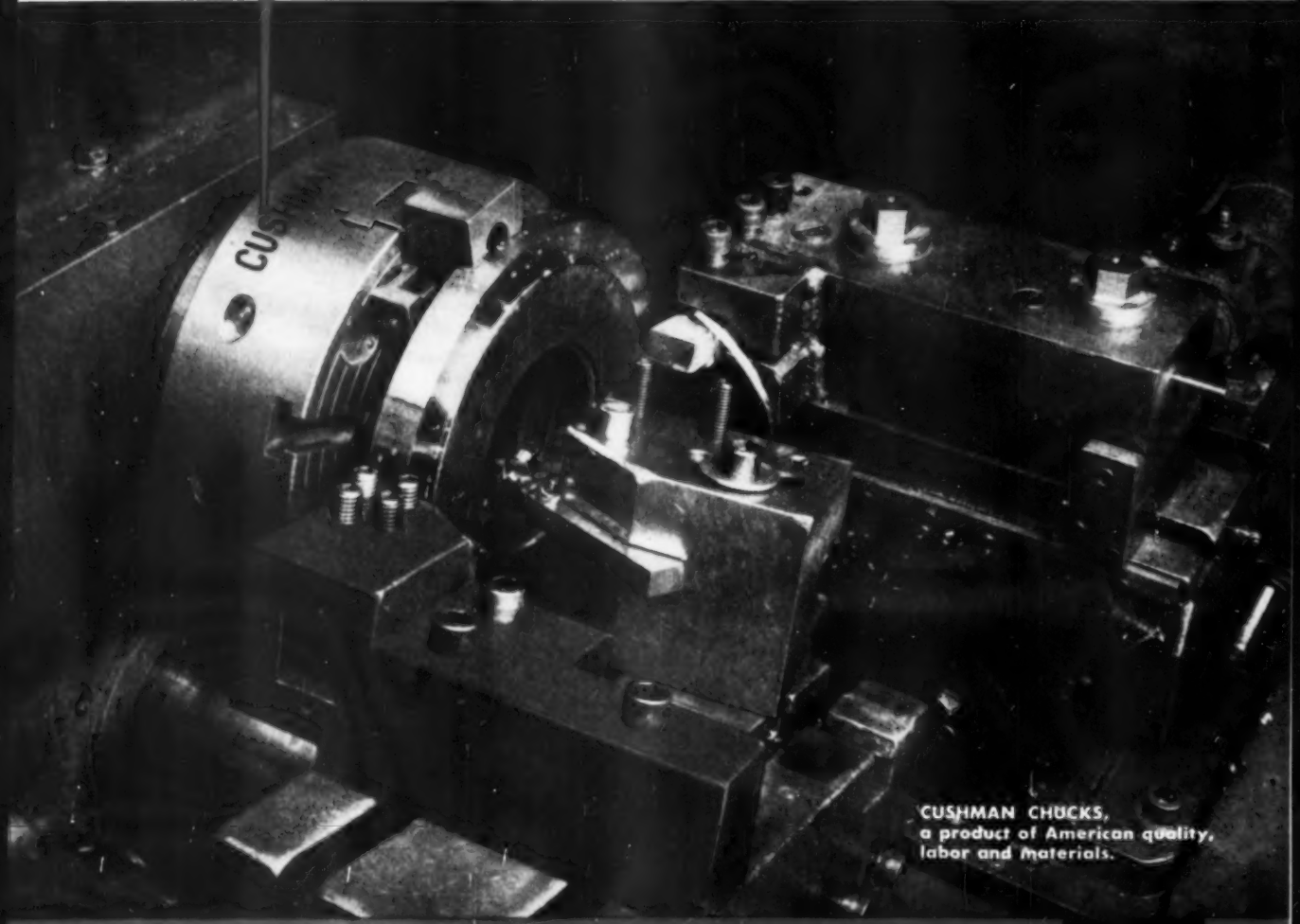
Cushman, the leading manufacturer of air operated chucking equipment, has designed and built a complete line of air operated chucks, cylinders and accessory equipment engineered to meet modern machine tool requirements of heavier feeds at higher speeds, maintain repetitive precision accuracy and positive gripping with truly fast workpiece chucking and unchucking.

Write today for your copy of Bulletin PO-65D and see how you, too, can effectively beat production quotas and lower machining costs by using efficient, economical Cushman Air Operated Chucking Equipment.



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MACHINE TOOLS...

U S builder teams up with British . . .

A prominent U S machine tool builder is reported to have bought a controlling interest in a British company which has a modern machine tool plant in eastern Scotland. Announcement of the deal is to be made in the middle of the month.

The U S builder also is said to be conducting negotiations for a hook-up with a West German company. If this arrangement should materialize, it then would have manufacturing operations both inside and outside the European Common Market.

Interest soars in numerical control ...

Interest in numerically-controlled machine tools is soaring. One maker of a standard machine reports that about half its recent orders have been for machines with programmed controls. Another states that around 25% of its current backlog consists of machines which have one form or another of numerical control (despite the fact that the company has not been publicizing its activities in this field).

Almost all the orders are from customers who are spending their own money, not the government's. The machines will be used for commercial production work.

330 German exhibitors at Paris . . .

Sixth European Machine Tool Exhibition at Paris September 12 to 21 inclusive will have 963 exhibitors and will occupy 360,000 sq ft of display space in a new exposition building. This compares with 577,000 sq ft at the 1957 Exhibition at Hanover, Germany.

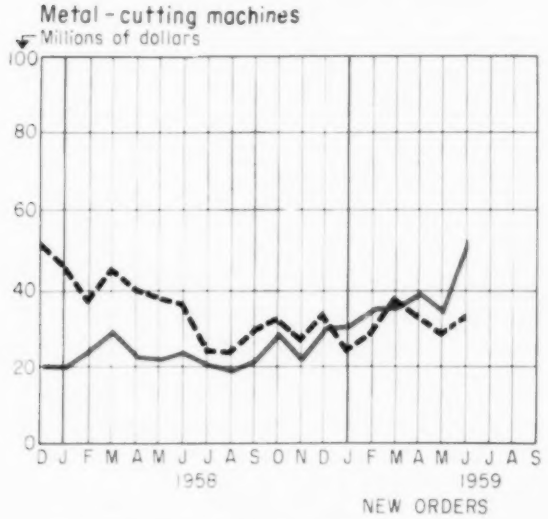
330 West German builders have taken 140,000 sq ft of floor space, or 38% of the total. 315 French companies have contracted for 100,000 sq ft.

There also will be 97 Swiss exhibitors, 90 Italian and 64 British.

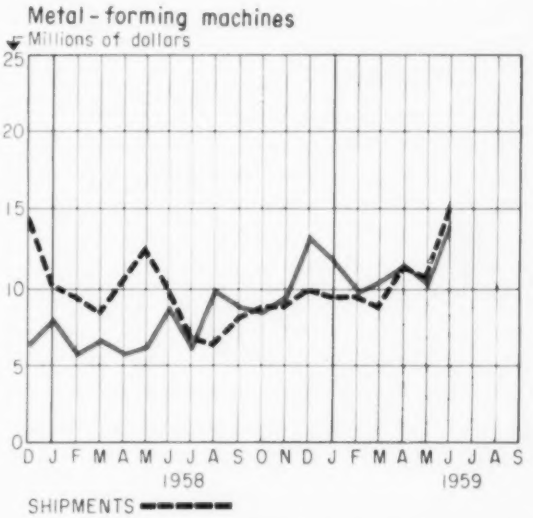
British have Soviet list . . .

Soviet Union has given the British a list of machinery requirements for possible import under the new Anglo-Soviet 5-year trade agreement. **It includes:** 1) transfer machines valued at 300-400 million rubles; 2) machine tools and gages for manufacture of small ball and roller bearings; 3) presses and forging machines totaling 60-70 million rubles; 4) gear cutting and grinding machines, turbine blade producing machines, and high-speed internal grinders valued at 100-120 million rubles. British Board of Trade says that there is no implication, in making the list public, that export licenses will be granted to any machine which is currently on the embargo list.

BT.

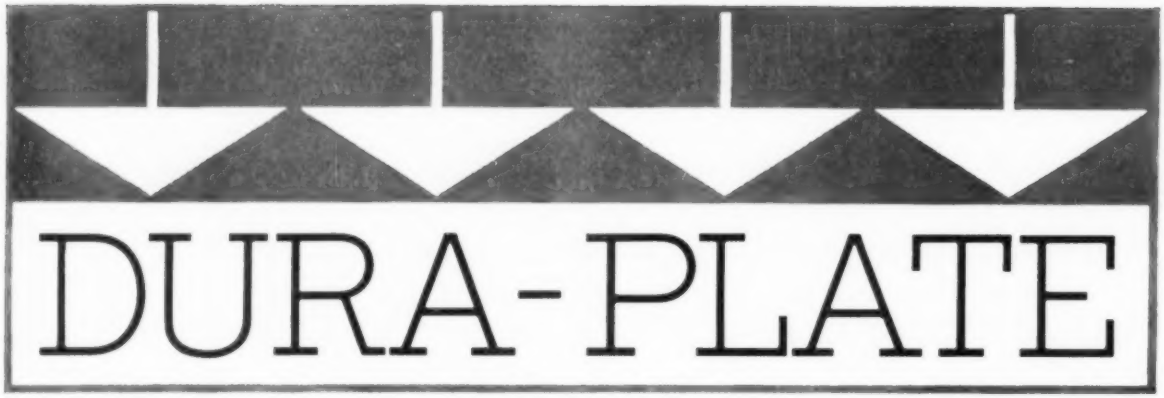


Sales of metal-cutting machine tools rose sharply in June to $53,550,000 from May's $37,500,000, as did shipments—from $30,350,000 in May to $37,250,000 in June. At the same time, sales of metalforming machine tools rose from $11,200,000 in May to $13,750,000 in June, and shipments



jumped from May's $10,650,000 to $15,500,000 in June. Backlogs for metal-cutting machine tools in June were at 4.3 months, compared with 3.9 months in May, while metalforming backlogs were at 3.5 months, compared with May's 4 months

BROWN LIPE CHAPIN



New Chrome Plating advance gives bright work new dimension in durability!

Here's a shining example of the many benefits available for your products at Brown-Lipe-Chapin. It's Brown-Lipe-Chapin's new DURA-PLATE! This new and unique process of chrome plating gives your product active sales appeal with the rich quality of gleaming chrome . . . and adds a new depth of durability that will last the life of your product.

DURA-PLATE consists of two layers of laminar and columnar nickel with a layer of chrome *five times as thick* as produced by conventional methods. The result is a surface almost impenetrable to corrosion. DURA-PLATE can be applied on any product made of steel, or on zinc die castings . . . at no extra cost!

DURA-PLATE is the result of the advanced research, the development of new techniques and thorough testing that continue at Brown-Lipe-Chapin to help make your products better.

DURA-PLATE is typical of the many benefits you get from Brown-Lipe-Chapin when you call on their extensive facilities for die casting, metal stampings of all kinds, electroplating, anodizing and painting.

If you're looking for a bright difference in your product, call on Brown-Lipe-Chapin, Division of General Motors Corporation, Syracuse, New York.

GM GENERAL MOTORS

RELIABILITY by BROWN·LIPE·CHAPIN

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MATERIALS...

Composite laminates...

Technical advances in bonding various metallic and non-metallic materials to laminated plastics have opened new design opportunities. According to the Taylor Fibre Co, Norristown, Pa, virtually any compatible material can now be bonded with a laminate to form a composite which combines advantages of both materials. Recently produced composite laminates include:

- **Vulcanized fiberclad laminates**—that combine the high strength of laminated plastics with the superior hot-arc resistance of vulcanized fiber. They are used in switch gear for both high and low voltage. For applications requiring high impact strength, the vulcanized fiber has further advantages.
- **Rubber-clad laminates.** Almost any natural or synthetic rubber, including Buna N and Buna S, may be used as cladding. These materials are used for condenser tops in wet condensers, to protect the laminate against highly alkaline electrolytes. They can be used in any part where sealing or chemical resistance is needed (as in battery tops) and for isolating vibration.
- **Asbestos-clad laminates**—composed of laminated plastic clad with untreated asbestos paper have heat and arc resistance.
- **Laminate-clad lead**—is used for x-ray shields. It is made by bonding lead sheets between Grade XX paperbase laminates. The laminate is said to provide both strength and improved shielding properties in the lead.
- **Aluminum-clad and magnesium-clad** laminates are used for engraving. As the laminate base is black, good contrast with the metal is provided when the design is etched out. Aluminum-clad laminates also have potential value in printed circuits, but the problems of soldering to aluminum must be solved first. Another application is in cassettes (x-ray plate holders) where aluminum acts as a shield and resists abrasion. Beryllium-copper-clad laminates also have printed-circuit possibilities.
- **Stainless-steel-clad laminates** serve a variety of non-magnetic purposes. Also, in corrosive environments stainless steel's resistance to attack is an asset to be combined with the benefits of plastic.
- **Silver-and-gold-faced laminates** provide a combination of strength and insulating ability with excellent electrical conductivity.

Vacuum-diecasting alloys...

New diecasting alloys are likely to come into prominence as a result of the growing use of vacuum diecasting (see p 2). With vacuum, just as much pressure must be used to fill the mold but it is believed that more viscous alloys having higher melting points and fatigue resisting properties can be cast. This means that many alloys, formerly considered impractical for diecasting, now can be used; that a wider range of physical and mechanical properties now is available to permit broader use of the diecasting process.

Improved vacuum diecasting techniques give urgency to a reevaluation of diecasting as a source of your product components. For example, the improved process is producing plumbing fixtures with strong, dense walls and webs only 1/16 in. thick and with surfaces smooth enough to accept direct plating without prior finishing.

Printed-circuit motors...

A development that could easily mean a major upheaval in electric-motor manufacture, and design, is underway at Photo Circuits, Inc, Glen Cove, NY. To date, printed circuit motors have been produced in a size range from 1/20 hp to 30 hp. The 30 hp motor operates on 230 volts, is 8 in. thick, and contains an 18-in.-dia. rotor. Overall diameter of the motor is 24 in. It operates at 82% efficiency and has a speed range of 0 to 3000 rpm. Because of its extremely low mass, the motor can operate efficiently at very low speeds; can start and stop rapidly.

A significant result of the small mass for the same torque is demonstrated by a 1/20 hp tape-handling motor which is started, stopped and fully reversed 60 times per second without excessive overheating. A thin disk of aluminum fastened to the side of the rotor serves as the brake. Eddy currents set up in the aluminum provide braking action in proportion to the rotor's velocity.

Originally developed in France, Photo Circuits is doing independent research on these motors. Because the conductors are parallel only in the holes, inductance is virtually zero. There is no arcing, no noise and practically no brush wear. (After 2000 hr of operation, a test motor showed no wear on the copper and only 0.0007 in. wear on the 50-50 silver-graphite brush.)

Typical expected uses include servo motors, tape drive motors, built-in machine-tool motors, auto-blower motors, and washing-machine motors. Engineers expect that printed circuit motors will completely displace conventional motors in the latter two applications. Major problem is separation of connections at high speeds.

PROBLEM

How to get used to rush jobs again

Threadwell

MAKES THE BEST PRODUCT BETTER

One good way to stay on top of the job is to standardize on Threadwell cutting tools and gages which relieve the worry about down time and rejects. Uninterrupted production and precision machining are Threadwell specialties. Convenient warehouses and a network of national Distributors take care of fast delivery, too. . . . and your Threadwell Field men and Distributors are glad to rush to give you a hand in production planning.

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Stocking Warehouses: New York — Cleveland
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WHAT'S AHEAD... in Metalworking

Metalworking heads for new highs...

Metalworking's consumer industries (autos, appliances and the like) continue to pace industry's upward climb—a climb that last month reached a new peacetime peak.

And the outlook is for a continued rise in production, barring a possible setback from strike-caused steel shortages. But the consensus is that the effects will be only temporary at best.

Much, too, will depend upon the reception the new U S small cars get when they debut this fall. Their introduction could possibly trigger off a record year for the industry.

Makers of automotive parts are enjoying their best output levels since 1945, report that shipments today are running nearly 40% ahead of like 1958.

Auto parts makers have built adequate, balanced steel inventories to the point where they can operate at normal levels for 60 to 90 days. Industry spokesmen characterize this year as "great," say they are going into the 1960 model year with a high rate of orders and deliveries.

The appliance industry outlook is rosy. Sales of major appliances in last half 1959 are expected to exceed those of comparable 1958 by a slight margin, and it will be remembered that last half 1958 marked the beginning of record production for the industry.

Sales of washers and dryers are expected to top 2.6-million units during the final six months of this year, slightly ahead of 1958 levels. Refrigerator sales traditionally drop off as cold weather comes on. Nevertheless, second half production will run about 1,425,000 units—only 50,000 units below first-half levels.

Electric range sales and output will hold this year to comparable 1958 totals: 375,000 units.

By year's end, the television-radio-phonograph industry expects to have racked up 6-million sales, compared with 5.2-million in 1958.

TV sales are reportedly outstripping inventory by about 35%. Radios are moving very well, as are phonographs. Incidentally, three out of four phonograph sales this year will be stereophonic.

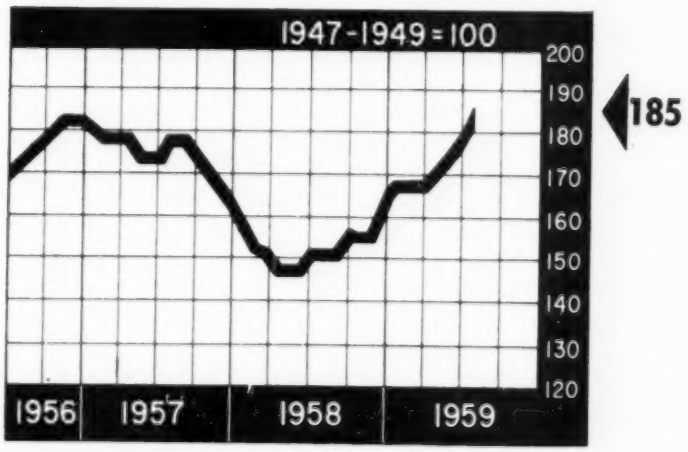
Farm machinery sales have slackened a bit from the terrific pace of a few months back. Even so, sales are 38% ahead of last year. Midwestern droughts, however, have cut into sales of such major machines as combines. Outlook for the rest of the year: "generally favorable."

Railroad car industry still isn't out of the doldrums and the overall carbuilding figure for 1959 probably won't show much change from that of 1958—around 17,000 units. The steel strike is a big factor in this industry: railroads are hit hard by it, and generally defer ordering new equipment until it is over.

Tool and die industry, a good harbinger of things to come in metalworking, is highly optimistic over the fourth quarter outlook, even though new orders have shown a tendency to seesaw.

Tool and die men, nevertheless, when quizzed as to the way they see business over the next few months answered this way: 11% "excellent," 49% "good," 32% "fair," and 8% "poor."

Compare the answers with those of a year-ago survey—2% "excellent," 21% "good," 52% "fair," and 25% "poor,"—and the outlook is exceptionally good, particularly when you remember that year-ago pessimism preceded a pickup.



AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

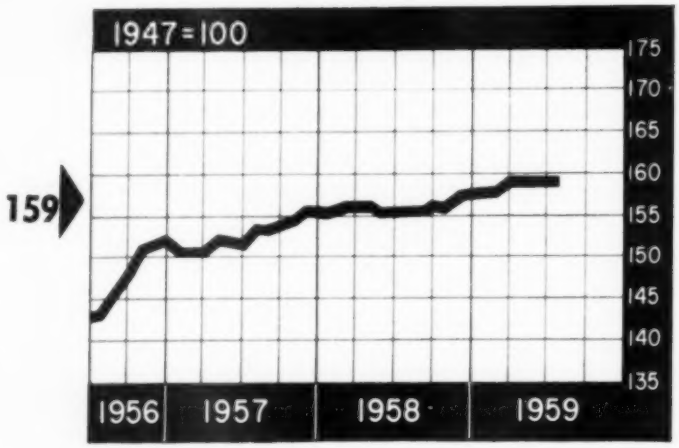
BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	JULY Estimated	JUNE Preliminary	MAY Revised	JUNE Year Ago
Total Index	**185**	**183**	**178**	**151**
Machinery	154	149	125	
Electrical Machinery	218	208	171	
Autos	139	136	88	
Other Transportation	351	351	352	
Other Metalworking	158	155	132	

TRENDS WHAT'S AHEAD... in Business

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	JULY Estimated	JUNE Preliminary	MAY Revised	JUNE Year Ago
Total Index	**158.8**	**158.7**	**158.7**	**155.9**
Metalworking Machinery	**185.3**	**184.9**	**180.9**	
Other Machinery exc. Electrical	**169.7**	**169.6**	**166.1**	
Electrical Machinery	**160.0**	**160.4**	**158.9**	
Fabricated Metal Products	**148.8**	**148.8**	**146.3**	



Consumer spending spurs output...

The gross national product for the second quarter of the year hit an annual rate of more than $483 billion, up by $13 billion from the rate for the first three months of 1959. Thus, by mid-year the economy was operating at a pace which, just a few months ago, was expected to be the peak rate to be reached by the end of the year. As things now stand, GNP should pass $500 billion —the half trillion mark—during the final quarter of the year.

Consumer spending has played a key part in swelling the output of goods and services. Spending for durable goods alone increased by almost $5 billion during the first half of the year, and total consumer spending rose by more than $12 billion.

By itself, consumer spending accounted for almost half the total increase in GNP during the first six months of 1959.

Rising personal incomes are, of course, the big factor behind the steadily increasing level of consumer spending—especially in the case of durables such as autos. Personal income for June was $383 billion, on a yearly basis, up $16 billion since the beginning of 1959.

Rising employment and a longer workweek have meant record levels of weekly earnings for production workers. During June, average earnings in manufacturing inched to another new record high of $90.54 a week. Consumer price hikes during June offset some of the wage gains made by workers in recent weeks, but real earnings of employees have shown a substantial improvement since the beginning of the year.

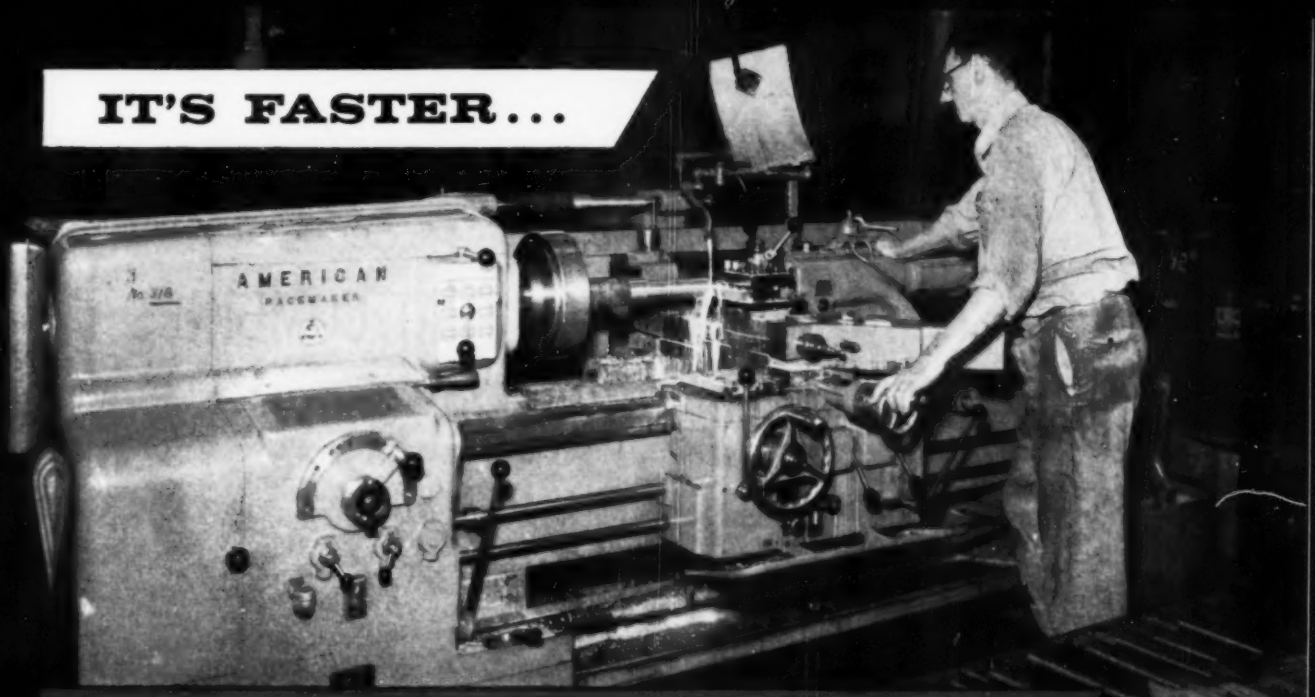
Consumer outlook continues to be cheery. According to the latest report by the Survey Research Center of the University of Michigan, a growing number of consumers see good times ahead. Consumers consequently will not feel a strong urge to save for the rainy day, and a bigger part of incomes will be spent for durable and new homes in the months ahead.

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-49=100)*	152.3	154.2	136.9
Steel ingot production (thousand tons)	362	365	1,561
Electric power output (million Kilowatt hours)	13,577	13,415	12,319
Production of automobiles and trucks	158,810	164,190	107,941
Engineering construction awards (Eng. News-Record, millions)	$331.5	$651.7	$388.0

MONTHLY BUSINESS INDICATORS	Latest Month	Preceding Month	Year Ago
Refrigerators sales (thousands of units)	308	301	263
Vacuum cleaners sales (thousands of units)	257	317	219
Washers sales (thousands of units)	207	278	263
Household electric ranges sales (thousands of units)	72	80	53
Radio production (thousands of units)	1,039	1,040	655
Television production (thousands of units)	432	389	267
Gear sales index (1947-49=100)	241.0	255.6	142.2
Foundry equipment new orders index (shipments, 1947-1949=100)	157.0	154.2	136.1

* Seasonally adjusted

IT'S FASTER...



IT'S A BIG IMPROVEMENT...

IT'S A MONEY MAKER!

These are exact words from the production officials of The Cleveland Worm and Gear Company, of Cleveland, Ohio, which company produces the universally known and widely used Cleveland Worm Gear Speed Reducers.

The machine to which they refer is their new "AMERICAN" DeLuxe Model Hydraulic Duplicating Lathe. This lathe, as the illustration shows, is used primarily for machining worm forgings from a round template.

Accurate duplication of parts, high speeds, heavy cuts, plenty of power, quick acting air operated tailstock and ease of operation are the major characteristics contributing to the amazing productivity of this machine.

More production per man hour is the answer and only answer to spiraling costs—modern, high production machinery is the answer to greater production per man hour. Judging from reports, The Cleveland Worm and Gear Company has found this to be true.

Bulletin No. 135 gives a complete description and shows many examples. It's yours for the asking.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

CIRCLE 228 READER SERVICE CARD

HERE'S A SPRING METAL THAT COMBINES

- **Excellent Elastic Properties**
- **Strength at High Temperatures**
- **Good Workability**
- **Resistance to Corrosion**

Armco 17-7 PH Stainless Steel specified for wide variety of springs that operate under severe conditions; replaces more costly spring materials.

Unusual combination of properties possessed by Armco's special precipitation-hardening stainless steel, 17-7 PH, has made it a popular material for springs that must resist heat or corrosion.

Armco 17-7 PH Stainless Steel—

– has ultimate tensile strength up to 350,000 psi (wire in Cond. CH900); elastic limit of the order of 75% of the ultimate tensile strength; torsional modulus of 11,000,000 psi.

– resists corrosion like Type 302 stainless steel.

– retains valuable elastic properties at temperatures as high as 650-700 F.

– has good fabricating characteristics, low temperature heat treatment after forming.

– is available in wide range of sizes of bars and wire, in variety of conditions; also produced in sheets and strip.

Consider how these advantages of Armco 17-7 PH Stainless can be used to improve performance or cut costs of springs in *your* products. Write for complete design and fabricating data on this unique spring material. Armco Steel Corporation, 2889 Curtis Street, Middletown, Ohio.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

American Machinist

MAGAZINE OF
METALWORKING PRODUCTION • ESTABLISHED 1877

The Only Answer To Mr K

In that historic informal exchange of views in Moscow, Mr Khrushchev told Mr Nixon that the Russians fully expect that their economy will overtake ours before long. He tauntingly said that they will wave to us as they pass us by.

The easy thing to do is to shrug off Mr K's remarks as a joke or a threat far removed from reality. We would be much smarter, however, to take them seriously and see what has to be done to prevent their coming true.

Mr K has a big advantage...

over us. He can decree what Russia's economic program is to be. All Russian resources then can be mobilized in support of the program.

One of Mr K's dicta is to build new plants equipped with new production machines of today's design and performance. Along with this goes a decree to keep existing factories up-to-date by means of an extensive modernization and replacement program.

Russia's top industrial management group has gone on record with the belief that new equipment should be replaced in less than ten years from its installation date. If that is not done, introduction of new technology will be intolerably delayed.

This is straight thinking...

If Mr K is successful in carrying out his proposed gigantic expansion and modernization program, and he seems well on his way, we may feel the hot breath of the Russians on our neck.

We will feel that hot breath, that is, unless we manage to stay far enough in the lead. But if we are to maintain our lead, a large amount of hard work is cut out for us over a long period of time.

To start with, it is not enough for us to have the plant capacity and equipment with which to produce goods in prodigious volume. It must be the right kind of equipment if we are to turn out the goods at low cost and sell them at prices within the reach of the buyer.

It is no good to design new products and then make them on old machines by high-cost, outmoded processes. Prices then by necessity will be high and competition in domestic and world markets will become difficult if not impossible.

The only way in which we can take full advantage of the new technology now developing so rapidly is to be constantly vigilant to see that obsolete equipment is discarded and the most modern equipment put in its place. If we will do just this on a continuing, never-ending basis, our economy will grow further and our standard of living will rise.

To accomplish this objective...

we must put our faith in the initiative, good judgment and competitive enterprise of every manufacturer who is in business to make a profit. We cannot rely upon a Washington equivalent of Mr K to run things for us.

We feel that our faith is well placed. Our system has worked industrial miracles in the past. It has given us the world's highest standard of living. We believe that the system will continue to work successfully. It can do so, however, only if tens of thousands of managements are and will continue to be as conscious as Mr K of the absolute necessity for investing in machines designed to put today's advanced technology to work.

Burnham Finney EDITOR

After 30 years' service these 8 Cleveland speed reducers needed no new parts!

Here are eight Cleveland Worm Gear Speed Reducers that have been on the job in this wire drawing plant continuously since 1929. Recently they were dismantled — then reassembled without *any* replacement of parts. Good for many more years of rugged service.

This is typical of the type service you can expect when Clevelands handle the right angle transmission of power in your plant. They save space and make for easy installation.

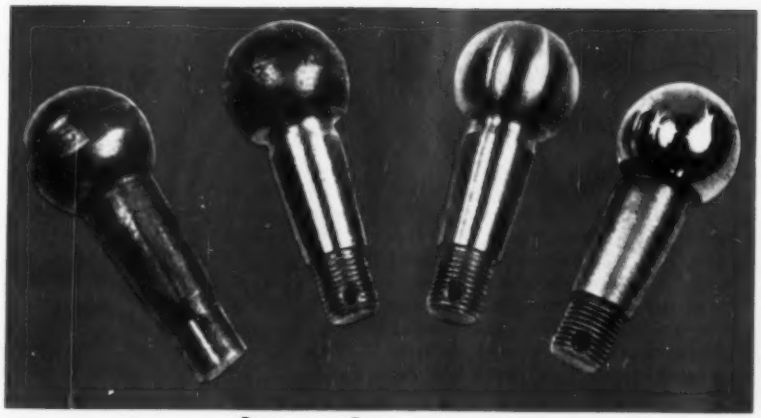
Before you buy machines or mechanize existing equipment, check and see what Clevelands can do to improve your operation. The complete story is contained in Bulletin #145. Write for your free copy, today.

The Cleveland Worm & Gear Company
3254 East 80th St., Cleveland 4, Ohio

A subsidiary of
Eaton Manufacturing Company

Affiliate: The Farval Corporation

CLEVELAND
Worm Gear
Drives



Ball studs are first upset . . .
to produce tapered shank, threads, and neck in AISI 8640. Then the ball ends are turned within 0.001 in. tir. Final operations are heat treating, grinding, and lapping

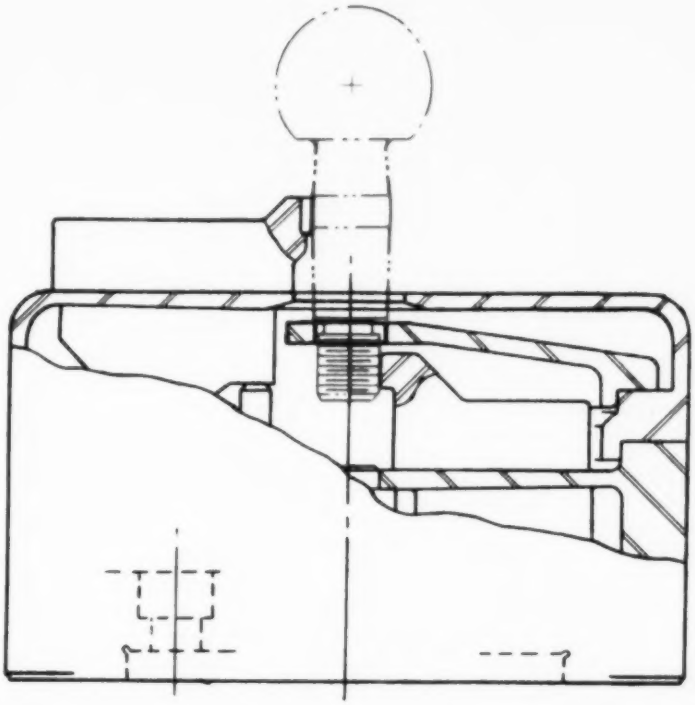
These parts *don't slip* under heavy turning loads

Special diaphragm chucks grip automotive ball studs so as much as 1/16 in. of stock can be removed in 12 seconds. The high-production setups are at Chevrolet's Bay City, Mich. Parts division, where two upper and two lower studs are produced for each car. They assemble into the steering-knuckle control arms.

High production in this case means 30,000 ball studs per day; but accuracy is required, too. The dimension from the base line to the center of the ball must be within ±0.001 in., and ball size and concentricity are held to the same tolerances. Although the balls are upset to leave a theoretical 0.02 in. machining stock on the radius, actually there may be as much as 1/16 in. on the radius to be removed.

Special N A Woodworth diaphragm chucks were developed to fit Hoern & Dilts 8-spindle machines to grip the parts under heavy cutting loads. As much as 3/32 in. has been removed from the side of a stud without making the work slip. Eight chucks are installed on the rotary indexing machine table—arranged in four groups of two each—at 90° spacing. There are six machines set up for this part, so there are 48 chucks working; 24 for upper ball studs, 24 for lower ball studs. Ball dimensions (finished) are 1.325 and 1.265 in. respectively.

Two parts are turned simultaneously in each setup with the work revolving at 1200 rpm and a cutting tool feeding at 0.004 ipr. A pair of parts is finished in 12 seconds. After being turned, the ball studs are installed in Van Norman machines where the stud balls are ground and lapped; uppers to 1.312 in., and lowers to 1.250 in.



Special chucks grip studs . . .
two at a time at four positions on a rotary table. Studs are stopped by shoulder between thread and tapered shank, and are gripped on straight section of shnk. Cutters start at the top at 25° angle to vertical, then move down the ball with curved motion

Switch from twist to gun drilling

Gun drilling is the answer when long, small-diameter holes must be smooth and accurate. That's what Detroit's Mallory Electric Corp found when demand for aluminum automobile distributor housings reached the point where Mallory's twist-drilling methods just couldn't keep up with increased production needs for the precision-drilled product.

Gun drilling, Mallory found out, not only improved the product—it cut production costs, eliminated rejects, cut down on maintenance and released personnel and conventional equipment for other work.

Trouble with twist drilling was that it produced bind marks in the long (nearly 10 to 1 length-to-diameter ratio) bores, making reaming a necessary second operation to remove the marks and to some extent straighten eccentricities caused by deep-hole twist drilling.

And even after reaming it was difficult to fit the housings to holding fixtures in subsequent operations, where the bores were used for locating. In all, about 147 pieces could be twist-drilled and reamed in an eight-hour day . . . and rejects ran to 9%.

Mallory's new gun-drilling technique is now turning out around 575 pieces in an eight-hour day, and there are *no* rejects.

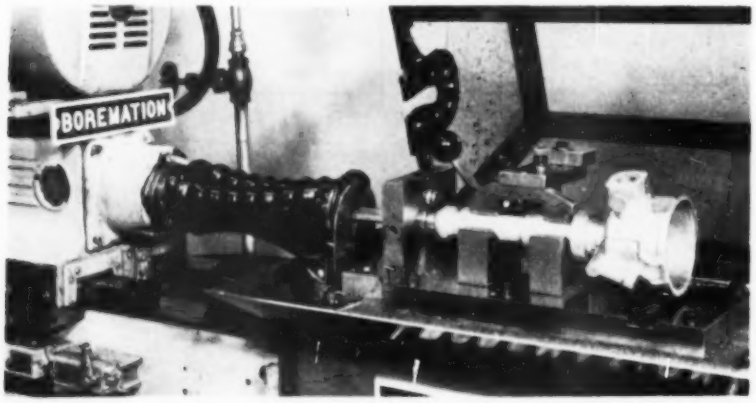
Not only that, one machine now does the work of four. It's a standard Model 1200 hydraulic way-type "Boremation" gun-drilling machine made by Drillmation Co of Center Line, Mich. Only one operator is now needed, instead of three with the old setup, and two holding fixtures are used instead of five. Maintenance costs run about 1% of what they once did.

Now a wide variety of housings are gun drilled in the two fixtures, each of which can accommodate a number of different parts. Quick-acting clamps hold the work on the OD against V-block surfaces of the fixtures while the aluminum castings are drilled from the solid.

As many as 20 different distributor housings are handled in this single setup—all of them with the same diameter bore (the variance is in length only). These bores (0.625 in. dia) run from 2 inches long for marine installations to 12 inches long for auto engines. Lot sizes vary from 200 to 1000 pieces.

Gun drills are HSS with carbide cutting heads and tips, run at speeds of 5050 rpm and feeds of 12 ipm. Coolant, an important item in gun drilling, is applied at 12 gpm with 1200 psi pressure.

With reaming eliminated, the new setup uses a locating pilot with a spotfacing and counterboring tool, cutting the time for this operation in half. Overall results: surface finish close to 15 micro-inches rms and bores straight within tenths of thousandths TIR, an output increase of 74%.

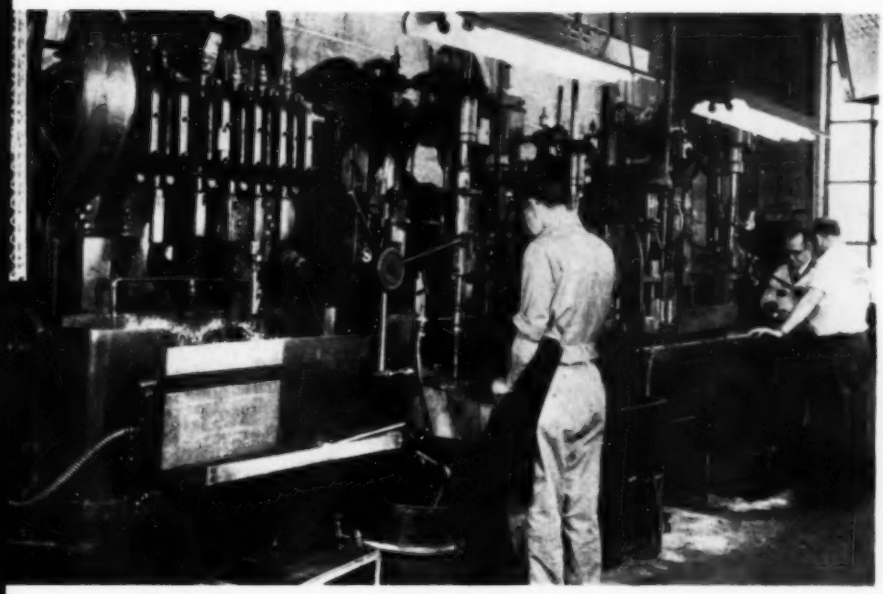


Chips and oil are confined to a small area . . .
. . . in Mallory's new gun drilling operation by means of this transparent plastic cover. Rubber boot over the gun drill directs coolant from the flute of the drill back to the collar, where there is an outlet for recirculating it through the system.

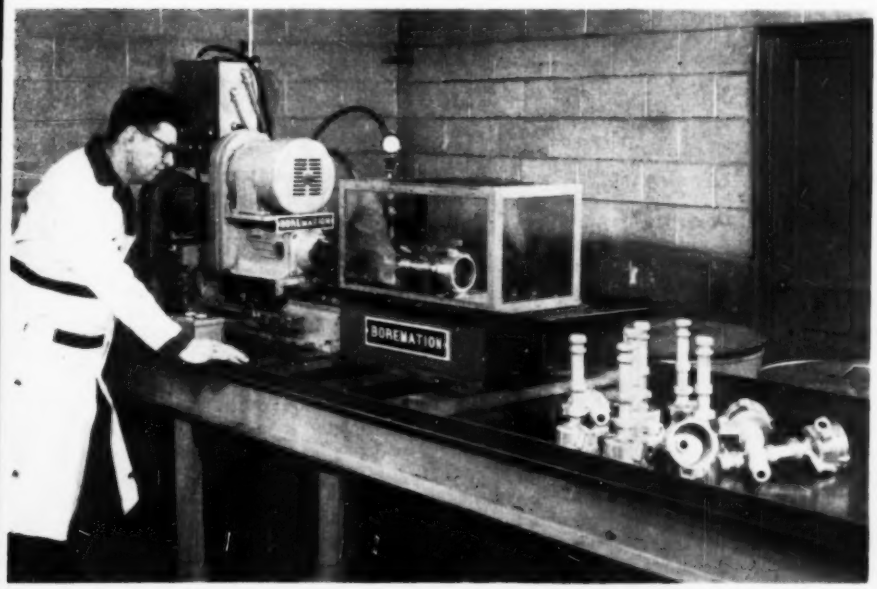
BEFORE

AFTER

ups output 74%



Twist-drilled long bores (left) had bind marks that had to be removed by reaming. Reject rate was 9%. It took five drillpresses and eight holding fixtures (right) to do the job. Three operators were required



Gun-drilled bores (left) are straight and true. One machine (right) replaces five, and only two holding fixtures and one operator are needed. Ultimately, spotfacing and counterboring with gun drilling will be included in this setup, eliminating another machine that now does those jobs

Capital spending trend: fewer new plants, more modernization?

One of America's biggest companies, Westinghouse, is going to spend as much or more on modernization of existing plants over the next seven years as it will on construction of new plants, Westinghouse's George W Jernstadt recently told members of the American Society of Mechanical Engineers.

The company is trending toward modernization rather than new construction for several reasons: (1) it is not necessary to establish a new labor force, (2) high start-up costs for new plants are eliminated, and (3) changes can be scheduled department by department without interrupting production.

In every case, Mr Jernstadt said, modernization reduces the cubic footage required to manufacture a product, and this means that floor space can be released for increased volume if necessary.

Westinghouse officials believe that the trend will be to fewer new plants in the next seven years than there were in the last seven years—but productivity will nevertheless continue to increase.

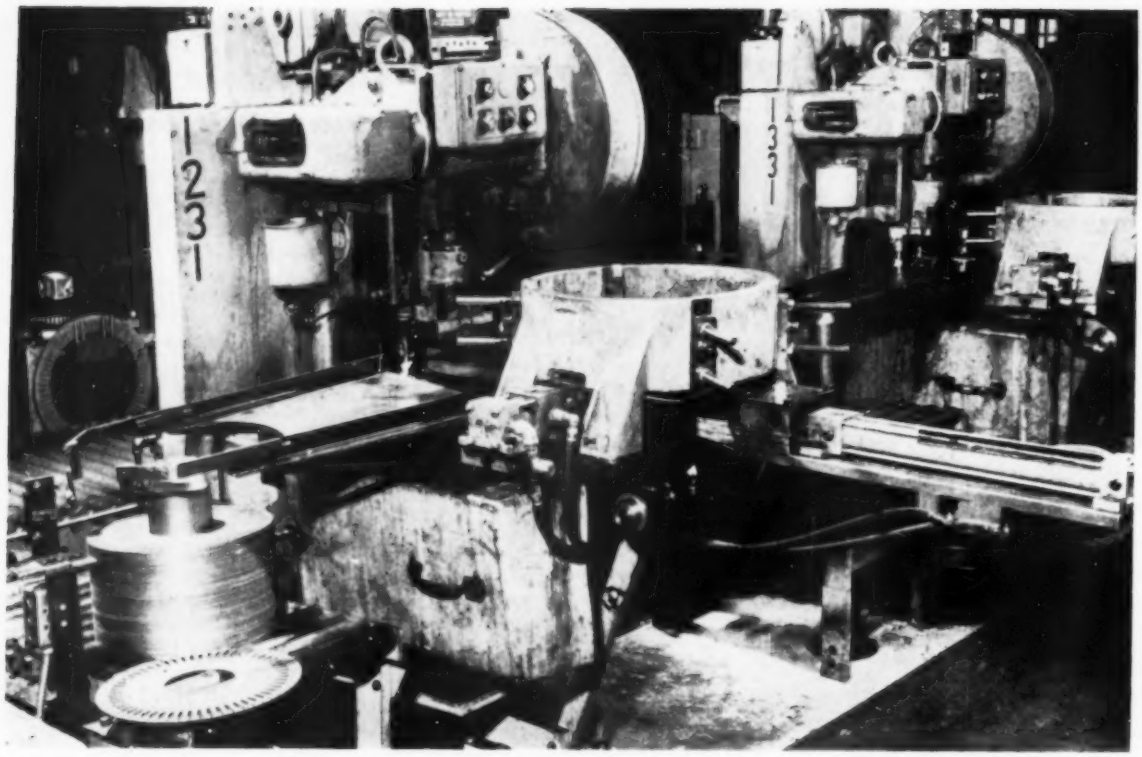
Stress on automation

Automation is playing a large role in Westinghouse's modernization program. Some of the company's individual lines have had their production rates increased as much as 100% in the last 10 years, and automation has enabled Westinghouse to increase lamp production from 1000 per hour to 3000 per hour.

Equally notable improvements have been achieved, Mr Jernstadt said, in job shop operations—simply by lining up related operations so that parts move progressively through the job shop.

Even high-cost automatic equipment is paying off at Westinghouse's job shops, Mr Jernstadt said, providing that such equipment has a high degree of flexibility.

Such machines, he added, are keeping the U S ahead of Russia in output, even though the Russians claim to have made more machine tools than the United States in the last year—"We do not need to build more machines than the Russians . . . We do need more productivity in our facilities. The two are not synonymous."



From experience with a mechanized press shop, we can talk about...

Magazine-fed notchers: How good?

By William S Atkinson, manufacturing engineer,
Small A C Motors and Generators Dept, General Electric Co, Schenectady, N Y

In our case magazine feeds allow us to achieve the desired level of mechanization without impairing flexibility

Flexibility is critically important to our division, which makes a wide range of motors. The diameters of rotors—and of stators, too—vary greatly. The notching press, with its high-speed, single-punch operation, provides the desired combinations of tool simplicity, tool interchangeability, and the required area for the full range of lamination diameters. We cannot afford to lose any of these characteristics by mechanization.

Magazine feeds were consequently considered not only in terms of their efficiency but also in the light of their influence on the inherent flexibility of the notcher. They proved surprisingly adaptable. It takes 1½ to 2 hr to set up a machine for each different run. (Incidentally, we were the first to use magazine feeds for notchers).

The earliest magazine feeds available to us in 1954, when we started our modernization program, accommodated rotors ranging from 6 to 9 in. dia. Subsequently, as the manufacturer of the notching machines (Hudson Division of the Emhart Manufacturing Co) expanded feed capacity, magazine-feeds were extended in range to include diameters from 9 to 13½ in.

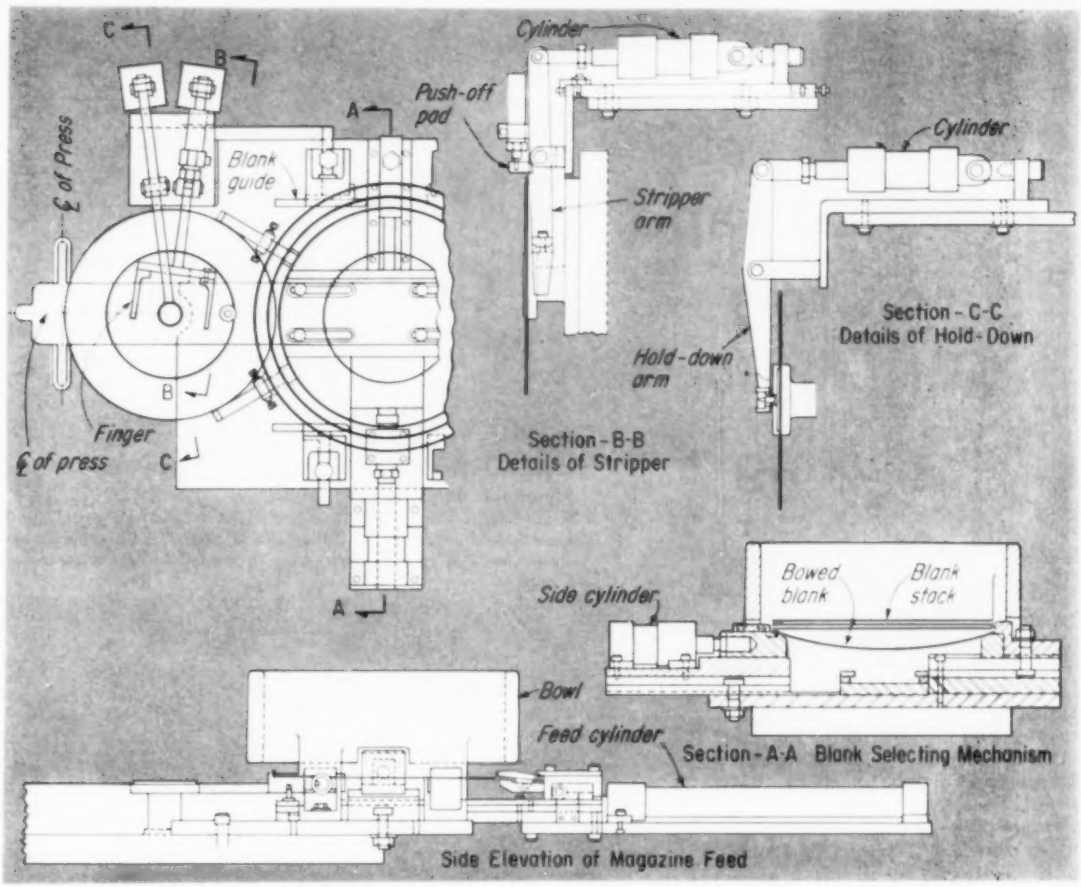
With magazine-fed machines, one operator handles several presses. He sets up, loads the magazine, watches for trouble and makes spot rejections. Everything else is done mechanically.

The lamination blanks are placed in a bowl-type magazine, from which the bottom lamination is fed to the notching fixture. The feed is pneumatically operated and the operation is rapid and positive.

The sequence of operations is as follows: A short-stroke air cylinder, mounted on the left side of the feeder, is actuated and moves a bronze slide against the bottom lamination in the stack. Enough pressure is exerted to slightly bow the lamination. The lamination is thus separated from the remainder of the stack. While in this position, it is seized by a pair of jaws and transferred to a position over the disk holder. The transfer jaws are pneumatically operated by a long-stroke air cylinder mounted in front of the feeder.

As soon as the lamination is positioned over the disk holder, the hold-down arm clamps the lamination on the disk holder. Now the notching cycle starts.

The transfer jaws and the side-operated slide return to their origi-



Elements of feed are basically simple . . .
Rotor blanks are placed in the bowl. Before a blank is to be fed, the side cylinder (Section A-A), causes the lowest blank in the stack to be bowed. At feed, the feed cylinder advances jaws that grasp the bowed blank and push it to the locator at the operating station. After notching is completed, the hold-down arm, Section B-B, is released, and the stripper arm and kick-off finger, Section C-C, push the part onto the chute leading to the stacking spindle

nal positions. During the notching cycle the next lamination is bowed and is ready to be transferred to the load position.

As soon as the notching cycle is completed, the hold-down arm is released and a stripper arm lifts the lamination from the disk holder. When the stripper arm lifts the lamination clear, a kickoff finger operates to eject the lamination through a chute mounted on the left-hand side of the press.

Automatic Unloading

The laminations build up on the spindle until it is full. At this point a limit switch is actuated, and stop bar is drawn back, allowing the full spindle to move down by gravity on an off-bearing conveyor.

The magazine-type feeder may be loaded while the machine is in operation, and an infinite number of laminations may be run without shutting down the machine to replenish the magazine.

Adjustments for size are made by mechanically moving four arms on the inside perimeter of the cast-iron feeder bowl. Two of the arms, toward the rear of the magazine, have holes drilled in the bar which correspond to the rotor sizes we run. These are moved into the proper position, a pin dropped through the hole to hold them in place, and a nut on the bar outside of the bowl tightened. The disks are then placed in the magazine, the other two arms moved into position, and the nuts tightened.

Presently, we have a number of V & O 410 rotor and stator notching presses with 100% tool interchangeability rated at 5-ton capacity with a speed range of 250 to 750 strokes per minute. Some of these rotor presses are equipped with smaller magazine feeds for laminations up to 9 in. in diameter. Several of these notchers are used for special stator punchings. Generally, however, stator punchings are punched out on 225-ton mechanical presses.

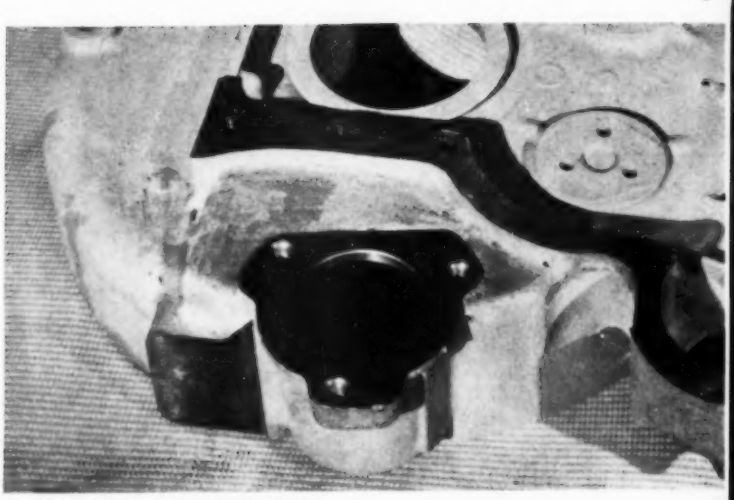
Larger-Size Feeds

The remaining rotor notching presses are equipped with the larger-size automatic feeds which produce slotted punchings for larger size motors.

Preponderance of machines used for rotors is accounted for by the fact that notching combinations on stators are fewer than those required for rotors. As a consequence fewer machines, operating on longer runs, can be employed for stators.

Punched tape controls automotive drilling

By George H. DeGroat, Detroit editor



Flywheel housing is drilled . . .
Nearest large hole is bored and chamfered to clear the starter; three holes spaced around it are drilled and tapped. Variations depend on starter position, engine size, whether engine is left-hand or right-hand

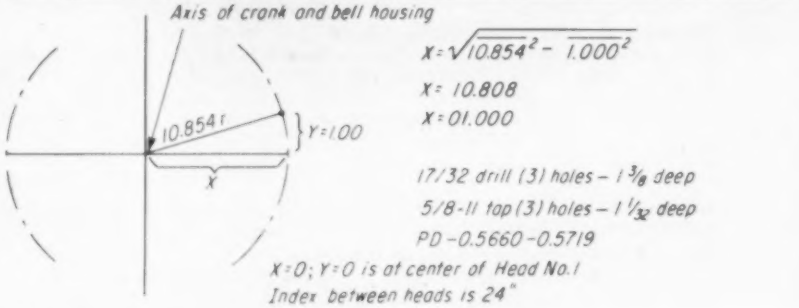
The first numerical tape control in automotive production is at Detroit Diesel Engine division of General Motors, where a two-axis Natco is drilling flywheel housings for a new line of engines. Tape control for this multiple-spindle, triple-head operation permits quick changeover between small (10-500 parts) lots, increases production 30%, and guarantees more accurate, more uniform work.

The job is to rough and finish a bore for the engine starter, and to drill and tap holes for starter-mounting bolts. The housings are made in eight sizes (SAE 4 through ½), for inline and V engines, left-hand and right-hand, with three different cylinder sizes. All these variations add up to 75-80 possible hole sizes and arrangements. Tape control handles these lots efficiently because a tape for each model can be programmed and stored handy to the machine.

Tooling is much simpler than before the Natco was installed. Individual boring plates for each different housing are no longer necessary; a single stationary workholding fixture handles the whole range of eight basic housings. One operator now runs the machine, and also handles a miller for other operations on the housings. It formerly required two men to bore, drill, and tap the parts.

The machine has three heads in line over the traversing table—which moves from head to head under tape control, not by standard indexing. A part is loaded at the first station, then the table moves it under the first head for boring. A typical hole is rough and finish bored to 3.625—3.627 in., then chamfered. Three positions, equally spaced for starter-mounting holes, are spot drilled by the same head. The table traverses to the second head, where the three holes are tap drilled. Finally, the table moves under the third head to tap the three holes ⅝-11. Tape control returns the table to unload position. Machine cycle time is about 208 seconds, based on feeding 15/16 in. at 1 ipm, 1⅞ in. at 4 ipm, and tapping 40 turns at 25 ipm.

		Coordinate	Auxiliary control	Operator instruction
Head No 1	X	10.808	1	0
	Y	01.000	~	1
Head No 2	X	34.808	2	0
	Y	01.000	~	2
Head No 3	X	58.808	3	0
	Y	01.000	~	3
Load & unload	X	78.000	R	0
	Y	00.000	R	4



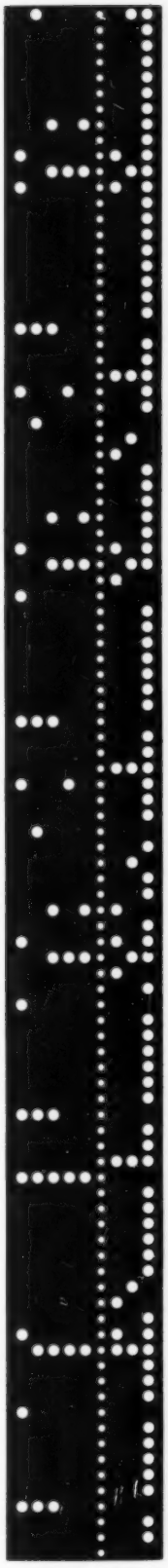
Tape programming takes 15 minutes . . .
X coordinates are calculated directly from the drawing, with 24 in. added for the index between heads. Coordinate for Y in this case is 01.000. Auxiliary-control column indicates which head is to be used, and shows when to reverse table to unload position

Tape programming is not complicated; it takes only about 15 minutes to translate X and Y coordinates from a blueprint to the tape. This is done only once for each variation of hole sizes and patterns.

Control is through feedback transducers geared to each leadscrew to convert shaft positions into electrical output that provides continuous

Triple-head drilling machine . . .
One fixture takes all parts. Table is positioned by tape control of traverse. Table speed between points is about 160 ipm

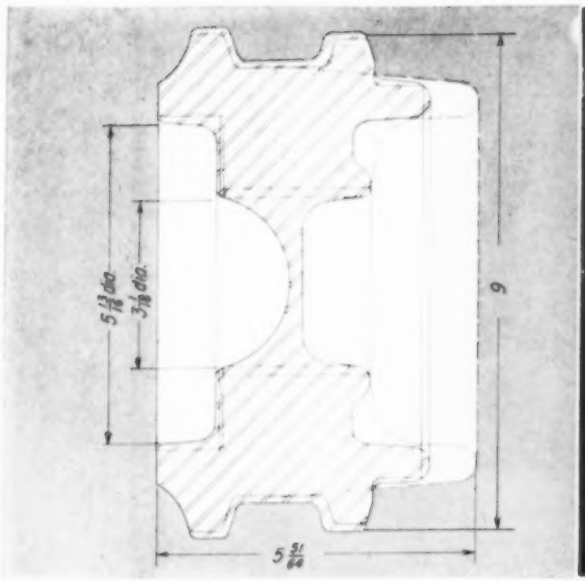
Operator punches tape . . .
First column (at far right) is to check continuity. Second two are digits before the decimal; next three are after the decimal. Last two columns identify the operating head and signal operation instructions—such as to turn on coolant

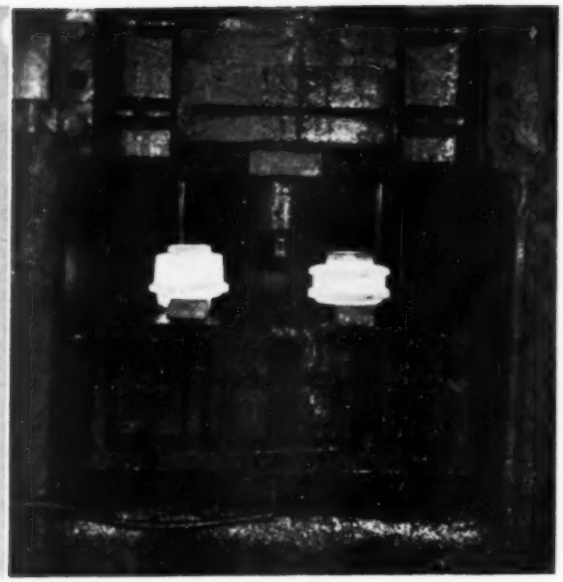


position measurement. A reversing motor on each axis (there are two) drives the screw through two sets of electro-magnetic clutches and brakes. Digital converters connected to each leadscrew through drive clutches signal the table location to a memory register in the control panel. This compares slide locations with command data stored in the memory unit.

Converters have five digit gears with ten contact segments that count leadscrew revolutions. Controls on motors, clutches, and brakes are signalled to reduce speed and stop at final positions.

When operations are completed, the reverse switch clears the memory unit. Entries for the next location are read into the memory unit while the table reverses, and the controls are re-energized to eliminate delay.





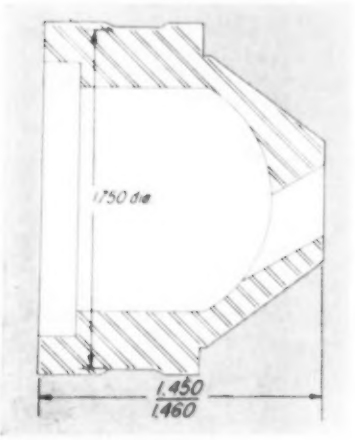
Central recesses on both sides of track roller require forging vertically, and so . . .

Press forging yields 6 benefits

Ability of the press to operate a split die ring was the means for upgrading the forging method

By Herbert Chase

There are cases when forging configuration can hamper production on hammers. Take for example, the double-flanged track roller made by International Harvester for a crawler tractor. Two operations were used for years. In the first one, the billet was hammer forged to produce one flange; in the second, the other flange was forged, using a split ring to form the recess between the flanges.



Closer finish . . .
reduces machining of press-forged precombustion chamber made of silicon steel

Although both operations were completed in one heat, the split die ring was the time-losing tooling detail. To remove the forging, the ring had to be lifted out with it, freed and replaced in the die. Tong handling of the hot ring parts slowed the operation. Besides, it was difficult to hold close limits in forging.

To reduce costs, the second operation is now done on a 2,000-ton forging Maxipress equipped with a die incorporating an air-operated split ring. The ring halves are operated by toggles. Easy and quick removal of the finished forging is obtained.

Advantages resulting from the change to the press-forging method are:

1. The production increase exceeds 30%.

2. Closer dimensional limits are held, and less flash is produced. Therefore, a slightly smaller billet can be used. The saving amounts to 1.5 lb of steel per forging.

3. Tool life of the split rings has been increased from 600 pc per set by the hammer method to 10,000 pc per set used on the press.

4. The forging is closer to required size. Hence, the amount of metal to be removed by machining is reduced.

5. Forgings are of better over-all quality and have less eccentricity.

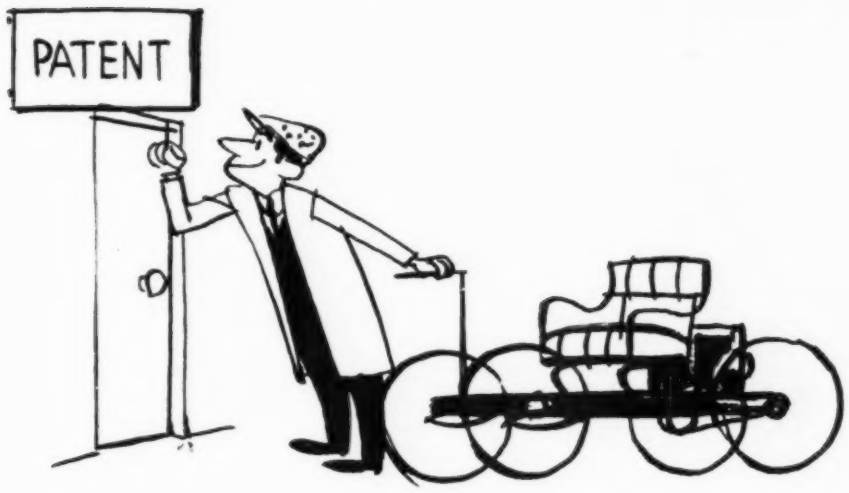
6. Safety of the operation is improved.

Tractor-roller forgings are subject to severe usage and abrasive wear. Therefore, SAE 1050 steel is used. After machining, a pair of rollers is joined by a circular weld made automatically. A central recess in the assembly forms a lubricant reservoir.

Changed from Upsetter

Another part now press-forged by IHC is the precombustion chamber for diesel engines. This part was formerly upset at a steel mill at the rate of 60 pc per hr. As-received forgings had $\frac{1}{8}$-in. stock allowance for finish machining, because of the difficulty in forging a material containing 3.5% silicon and 8 to 9% chromium.

Now International Harvester produces the part on a 1600-ton Maxipress at 200 pc per hr. Finish allowance is only 1/16 in. A kicker pin ejects the forging, making possible minimum draft. This draft is removed when the forging is hot trimmed. When a 2-cavity die is installed, production will be doubled.



What are company rights . . .

. . . when an employee gets a patent?

- **Does a company always have a right to inventions developed at its direction?**
- **Can an inventor keep his patent to himself even if he developed the idea at company expense?**

Recent court cases are clearing up some of the confusion that surrounds patents. Here are some examples, and some conclusions . . .

By Albert Woodruff Gray, Forest Hills, N Y

Inventions belong to the inventor—or do they? Under some conditions an inventor can retain private rights even if he developed an idea on company time and at company expense. But if there are previous agreements or conditions of employment, the company may gain some or all rights.

Cahill vs Regan, New York, Mar 5 '59

This case developed after the United States Ordnance Bureau suggested to a manufacturer that he develop a reusable munitions can (for fuses) similar to an existing German design. It was to replace the standard "tear strip" can (not reusable) then being purchased.

The company persuaded an employee to take over management of the business, which he did. During the following two years, while supervising the business, the employee developed a suitable can. This was manufactured and marketed by the company. After another two years the employee was granted a patent, after which he left employment—and was promptly sued by the company.

The court decided that the employer should own the invention and the patent if the employee had been hired to invent or had been assigned the task of devoting his efforts to a particular problem. But the employee should own the device and patent if his employment had been general and not confined to any particular research or invention problem. The court also commented that even when an employee is hired to invent, he is entitled to the fruits of his invention—in the absence of any express agreement with the company.

But to allow for use of company time, money, and equipment, the court granted the employer shop rights —the right to use the design regardless of the patent.

"Despite the fact that an employee may have an exclusive right to a patent, the employer will gain shop rights to use the invention if the employee, in developing his ideas, did so on his employer's time

What are company rights? . . .

and with his machinery, materials, and money."

DeJur-Amsco Corp vs Fogle, New Jersey, Apr 26 '56

An earlier decision in New Jersey involved the chief engineer of a plant that manufactured electrical and mechanical apparatus. The employee invented an automatic dual-range photo exposure meter and received a patent on it. His employer sued to get assignment of the invention, claiming that the company had paid for the work and was entitled to the proceeds. But the court denied the company, quoting a decision from 60 years before:

Dalzell vs Dueber Watch Case Mfg Co, U S, May 10, 1893

This was a U S Supreme Court case covering a skilled worker who had invented and patented watch-case tools. When he left employment, the company sued him for ownership of his patents. The court stated, "A manufacturing corporation which has employed a skilled workman for a stated compensation to take charge of its works, and to devote his time and services to devising and making improvements in articles there manufactured, is not entitled to the conveyance of patents obtained for inventions made by him while so employed, in the absence of an express agreement to that effect."

Barry vs Crane Bros Mfg Co, Illinois, Nov 10, 1884

But another court found for a company, for special reasons. An employee of a tool manufacturer developed and patented tools that were used by the inventor and others in the factory. When the worker left the company some years later, he sued for an injunction against further use of the tools by the company, and for an accounting of company profits. The court refused, saying, "It can hardly be possible that an employee, himself the owner of a patent, can introduce his patented device into his employer's business without his employer's consent and without a special agreement to pay him, and afterwards turn around and demand royalties and profits and damages from his employer for the use of such device, especially in a case like this where the device has been developed to a practical condition at the expense of the employer." The court concluded that the employer had gained shop rights to the tools, in spite of the patent.

Standard Parts Co vs Peck, U S, Feb 18, 1924

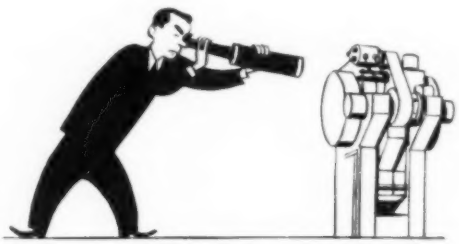
This case was different, because the employment contract for the worker stated that he was to devote his time to the development of a manufacturing process for a specific product. Although the worker had a patent, the court denied his right to it.

The agreement stated ". . . the second party is to devote his time to the development of a process and manufacture for the production of a front spring now used on the product of the Ford Motor Company."

"Whose property was the 'process and machinery' to be when developed? The answer would seem to be inevitable and resistless—of him who engaged the services and paid for them."

United States vs Dublier Condenser Corp, U S, Apr 10 '33

Two scientists working in the radio section of the government shortly after W W I were assigned to research on receiving sets in connection with control of airship bombs and marine torpedoes. While engaged in this work they become interested in the idea of substituting alternating current for the direct battery current then used in radio equipment. They were successful in following this new idea, and they received a patent on their work.



The government, convinced that the inventors were not entitled to ownership, sued; and the case ultimately came before the Supreme Court. The court reasoned that an invention based on direct assignment of work, whether or not there is specific agreement about future patents, should be assigned back to the employer.

But general employment does not require assignment of such a patent. The court made a point of the difference between an idea and its physical expression; the difference between an invention and production of equipment that utilizes the invention.

The general rule is that the invention belongs to the person who invented it. But if a company is responsible for allowing the inventor to put his idea into practice; to test it, make a model, and prove it in practice, then the company has a non-exclusive shop right to apply the idea.

"Since the servant uses his master's time, facilities and materials to attain a concrete result, the latter is in equity entitled to use that which embodies his own property and to duplicate it as often as he may find occasion to employ similar appliances in his business. But the employer in such a case has no equity to demand a conveyance of the invention which is the original concept of the employee alone in which the employer had no part. This remains the property of him who conceived it together with the right conferred by the patent to exclude all others, even the employer, from the accrued benefits. These principles are settled as respects private employment."

Control moisture...
and process vulcanized fiber without trouble

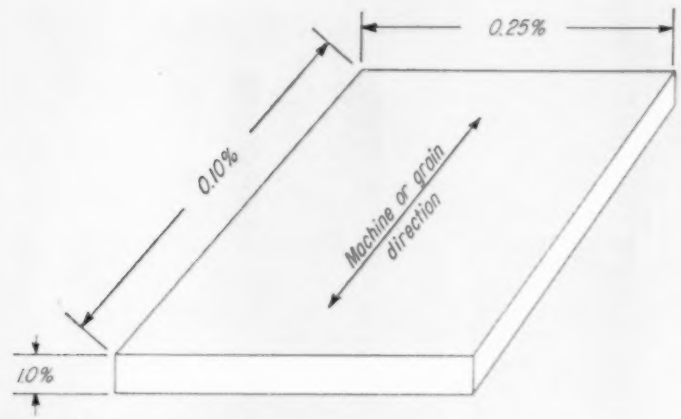
By George J Muller, manager, technical service, Taylor Fibre Co, Norristown, Pa

Vulcanized fiber is no tougher to machine than brass or aluminum, and it can be drawn and bent without danger—but there is one big IF with this material. If the moisture content is controlled, the material will act OK. If moisture content runs wild, dimensions will fluctuate and the stock will either crack or warp.

Right after the stock is manufactured, its moisture content is from 5-8% of the dry weight, which is ideal for fabricating. But storage brings in problems, which usually have to be solved by the fabricator. Dry winter storage in a heated room often means 20% humidity in the surrounding air. Vulcanized fiber under these conditions will drop off in moisture content to less than 4%. This means drying out, brittleness, loss of toughness, and plenty of fabricating difficulties.

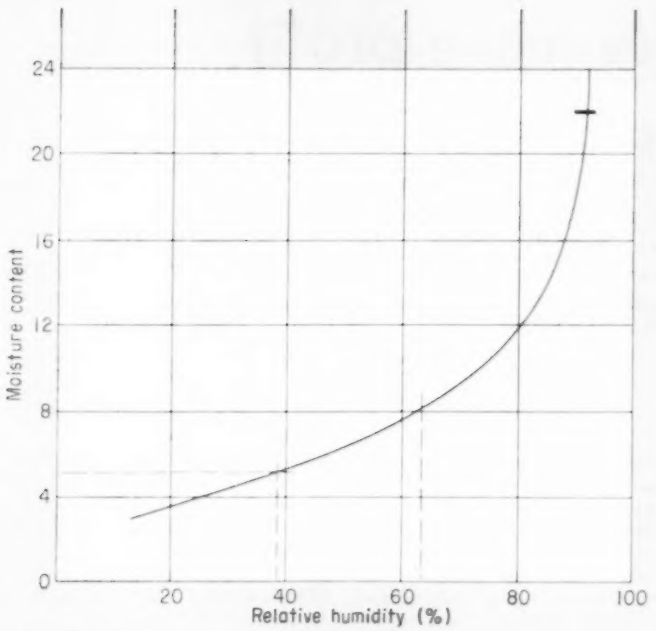
Storage in high humidity is also bad because the stock will warp and increase in dimension.

For best storage the surrounding air should be held at around 50% humidity. At equilibrium this produces about 6% moisture in the stock. During winter months, therefore, hot storage rooms should be equipped with steam jets or water vaporizers to maintain 50% humidity. And during hot, humid weather the stock should be either kept warm to maintain mosture at a low level, or should be dried out before being fabricated.



Dimensions change this much...

When moisture content of vulcanized fiber changes 1%, or when humidity of the surrounding air changes 10%. Moisture content can change 4% or more in 6 hr if humidity is changed.

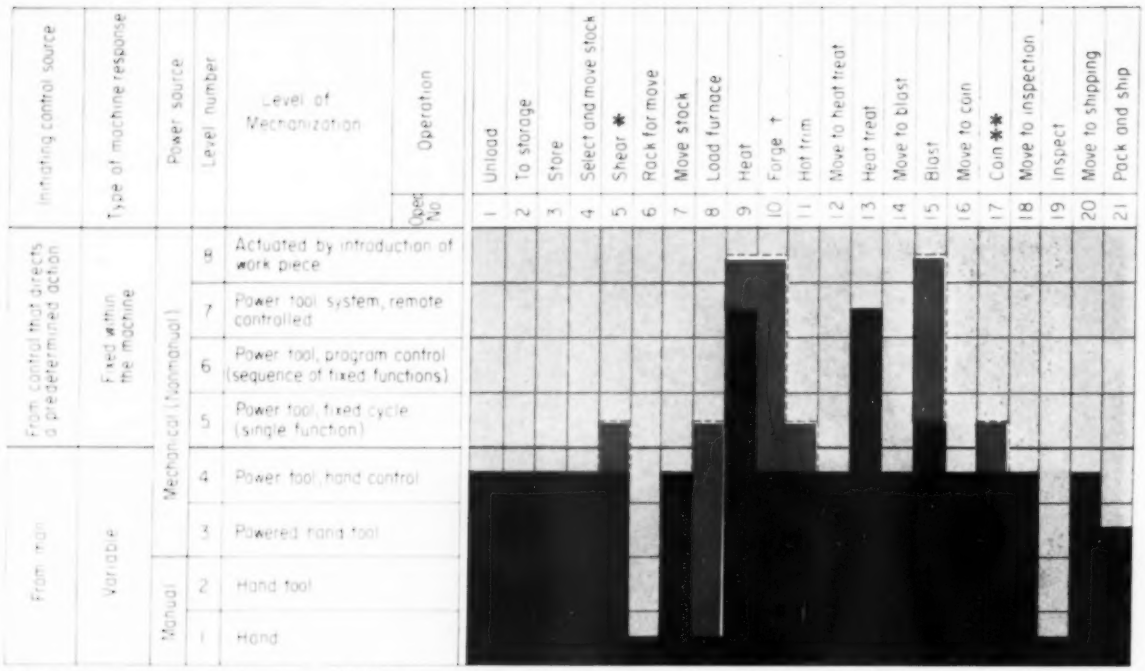


Equilibrium at 73F...

is reached according to this curve. Storage for several days or longer will result in moisture that depends entirely on air humidity unless special steps are taken.

How to Correct Dryness

Moisture can be added just before the material is to be fabricated in a number of ways. Brushing or wiping the surface with water will soften the skin in the zone of greatest stress, and this often makes machining much easier. Before punching, forming, and cutting operations on coils or strips 0.010 to 0.040 in. thick, moisture can be added by passing the stock over a wet felt or sponge as it feeds into the machine. Thicker stock may be soaked from 30 sec to 10 min or more, depending on conditions of the stock and severity of the forming operation to be performed. For most severe forming, the material should be soaked in 150 F water, and the forming tools should be heated to steam the fiber.



Profile of Mechanization . . .
each operation in a typical forge shop is charted (in black) against levels of mechanization, indicating continuance of an era where "human control and brawn are still the governing factor." Areas for profitable mechanization are spotlighted in color

How to make more profit from your forge shop

Many forge shops have changed their techniques very little in many years. To reverse the trend toward dwindling profits and inroads by foreign competition, suggestions for mechanization and methods improvement are made against the profile of a typical forge shop as it probably exists today

By Eugene C Clarke, Jr, president
Chambersburg Engineering Co, Chambersburg, Pa

Invasion of American markets by foreign automobiles, sewing machines, hand tools, instruments, and other devices having drop-forged components is with us. In short, we now find ourselves competing with industrial complexes that are achieving technical competency at an astonishing rate.

In considering the success of foreign imports, it is often said that alien wage rates are so low that American shops cannot compete. Yet our past successes have been gained by producing goods in which the wage cost per unit has been lower than competition. What we need now is a productivity break-through that will enable us to regain the ground that has been lost.

The case for forge-shop modernization is apparent. Satisfactory trends in productivity go beyond the scope of specific techniques or know-how. Careful appraisal of present production concepts is required with the objective of embracing as many of the advances in technology as seem feasible.

At this point it would be well to look at the nature of mechanization and to evaluate the status of drop forging. In his book "Automation and Management,"* Prof James R Bright has devised a method of

* Published by the Division of Research, Graduate School of Business Administration, Harvard University, Boston, Mass.

Adapted from a talk "Trends in the Productivity of Forging Equipment," delivered by the author before the annual meeting of the Drop Forging Association, June 23, 1959.

analysis that will serve the purpose admirably.

All of us are aware that mechanization has been applied to practically every productive activity but to different degrees. Prof Bright suggests 17 levels of mechanization and the value of setting up a profile chart of an operation to show the degree of mechanization or "automation" for each function. The first seven levels are relatively familiar, raising the most elementary technique to a remote, controlled-power, tooled system. Level 8 represents transfer of control from the operator to the workpiece. From this point upward, the various levels are differentiated more from a standpoint of control than on pattern of machine operation, and do not apply to the profile chart discussed.

Sources for savings

By analyzing each step in a production process according to its level of mechanization, one can examine in detail the difference between an actual level of mechanization and the theoretically desirable one. The executive or engineer can then consider whether improvement in a particular area will be economically justifiable.

Consider the mechanization profile of a typical drop forge shop. If this analysis represents average conditions, it is apparent that all operations, save three, are rated at level 4 or lower. In other words, human control and brawn are the governing factors in today's typical forge drop.

Just what can be done to mechanize the drop forging process and bring its trend upward to or even above that of competing processes? The drop-forging process is a "natural" for mechanization because it embodies the main features of automatic production—the storage of shape in dies.

Nine chances

The main operations that are related directly to the forging process and which are logically grouped for combination in a mechanized installation include:

1. Orient
2. Convey
3. Feed
4. Heat
5. Preform
6. Forge
7. Trim
8. Hot Shear (on occasion)
9. Descale (if needed)

The determination of the specifications of the most economic mechanized forging process must be based on studies relating to the demands that will be made on the equipment. The forgings to be produced might be classified with respect to weight, type of material, and operational sequence. Analysis of this data will suggest groupings of similar items; and, from this, a pattern can be defined.

A preliminary design of the process and the selection of the basic production equipment best adapted to the proposed "mix" is now possible. As we have seen, there will be several alternatives involving various degrees of mechanization, versatility, and productivity to be considered. At times, the project may be divided into phases and a timetable established for the progressive modernization of the forge shop.

The core of the process is the heating, forging, and trimming units themselves. The elements of the process are nothing more than the extension and improvement of operations and functions currently prevailing in most forge shops.

Usually individual cuts (or blanks) sufficient to make one forging will be prepared by automatic shearing or sawing. Alternately, mill-length bars or coils can be progressively heated for forging, cut to length, and then forged—all in the same heat. The determination of procedure is influenced by the in-process time.

Preformed blanks

Another method is the use of preforms blanked from rolled stock. The flexibility of blanking dies and the simplicity and practicability of automatic feeds for the blanking press serve to enhance the use of this method.

Movement of stock through each successive operation of the heating and forging process can be accomplished by mechanisms synchronized with the major unit of that series. Generally, furnaces will be served by their own conveyors. Whenever possible the individual operational group's cycling rates are matched, so that the most efficient utilization is made of each unit of equipment. Overall controls should incorporate such features as programmed start-up and shut-down; feed shut-down and hot rejections in the event of a mechanical failure; and warning devices signaling such things as low stock supply, mal-functions of feeds, power failures, etc.

Die designing and die making will be improved by the adaptation of mechanization to closed-die forging. In general, deformation should occur with the fewest blows within the shortest possible time. Knowledge of heating and cooling rates will be essential to the planning of a production setup. Usually it is advantageous to use as many graduated die stages as feasible within the limitations of available time at forging temperature. With this the output per die sinking will be best.

Once mechanization is accomplished, the prime area for further cost reduction will be in the further improvement of die life. Open-die impressions can be utilized for working the material with multiple blows. Closed-die impressions are most effectively used with single blows of predetermined energy. There are a great number of jobs that can be made in a single blow in one closed-die impression. It will not be uncommon to have ejectors built into dies for forgings of particularly deep draws with minimum draft alowances.

Cheaper die making

Insert-type impression dies lend themselves to this type of production. With these, economies can be realized by the use of harder die steels and by the fact that individual die impressions can be replaced as they wear out. Such dies lend themselves to production by erosion methods or by die typing. More extensive use will be made of preforming die stages, and these, most often, can be simple, open-type dies.

Mechanization will bring with it the precise location of stock relative to the die impression and will permit the use of tolerances so much closer than possible with hand positioning that very often less stock can be used.

It will be up to equipment designers to provide tools that will fit together in production lines designed to accommodate various combinations of operations. By utilizing "building block" techniques in the design of the feeding devices, a wide degree of flexibility can be achieved in stock handling.

Up goes production

Hourly production rates with a fully mechanized forging installation will exceed those of hammers. Steady, tireless and uniform production rates will be possible resulting in increases of at least 60% in tonnage per hour per unit.

Drop forgers have prospered while overcoming problems just as great in raising the smith shop of yesterday to the precision operation of today. The rewards of tomorrow's automated forge shop promise to completely justify the efforts trending toward increased productivity.

Automatic lubrication cuts forging costs

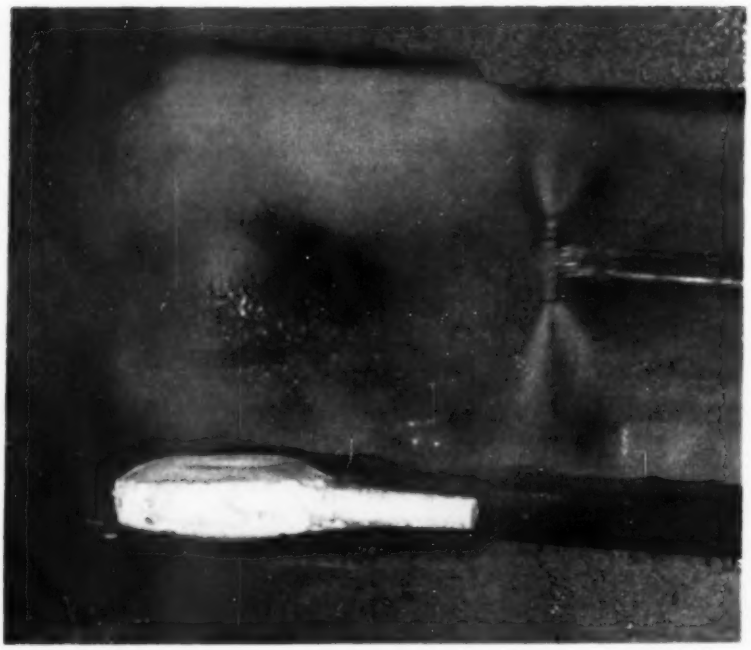
Big economies are Buick's reward for switching over to automatic lubrication in the forging of steering knuckles. How? In higher output, lower labor costs, and less lubricant waste.

In forging, good metal flow depends a lot on getting the right amount of lubricant to the right spot at the right time. The complex SAE 1340 steering knuckles you see on this page are a complicated forging job. Without good lubrication, these parts couldn't be forged at all.

Three-stage dies forge these parts, in special Ajax 3000-ton presses. Cyclic rate is over 5000 strokes per hour, although the Buick setup requires only about 2700. It takes three press strokes to turn out a complete part: During the first stroke the blank is flattened horizontally. Next, the stem is inserted vertically into a pilot hole for the first extrusion. The final extrusion is similar, and concludes the operation except for trimming.

Formerly, an extra man had to be stationed at each press to lubricate the dies by hand. This system had its disadvantages. It was almost impossible to get an even distribution of lubricant; some parts of the die got too much, others too little. Much of the lubricant was being wasted, 72 gal. of lubricating compound were needed for an 8-hr shift on three presses. More important, imperfect lubrication was making the percentage of rejects high.

To clear up this problem, Buick added a Calco automatic die lubricator (Columbia Automatic Lubrication Co.) to each press. Each Calco unit is air operated and electrically controlled. All the operator has to do is push a button just before the first stroke in each cycle. The nozzle automatically enters the space between the dies, sprays just the right amount of lubricant exactly where needed, then retracts.

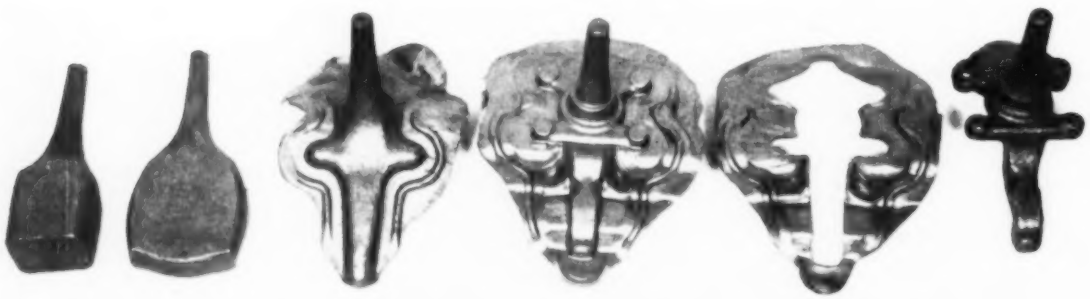


Automatic lubricator . . .
swings in before forging cycle begins, deposits just the right amount of lubricant. This automatic equipment halves lubricating costs, steps up output and cuts rejects

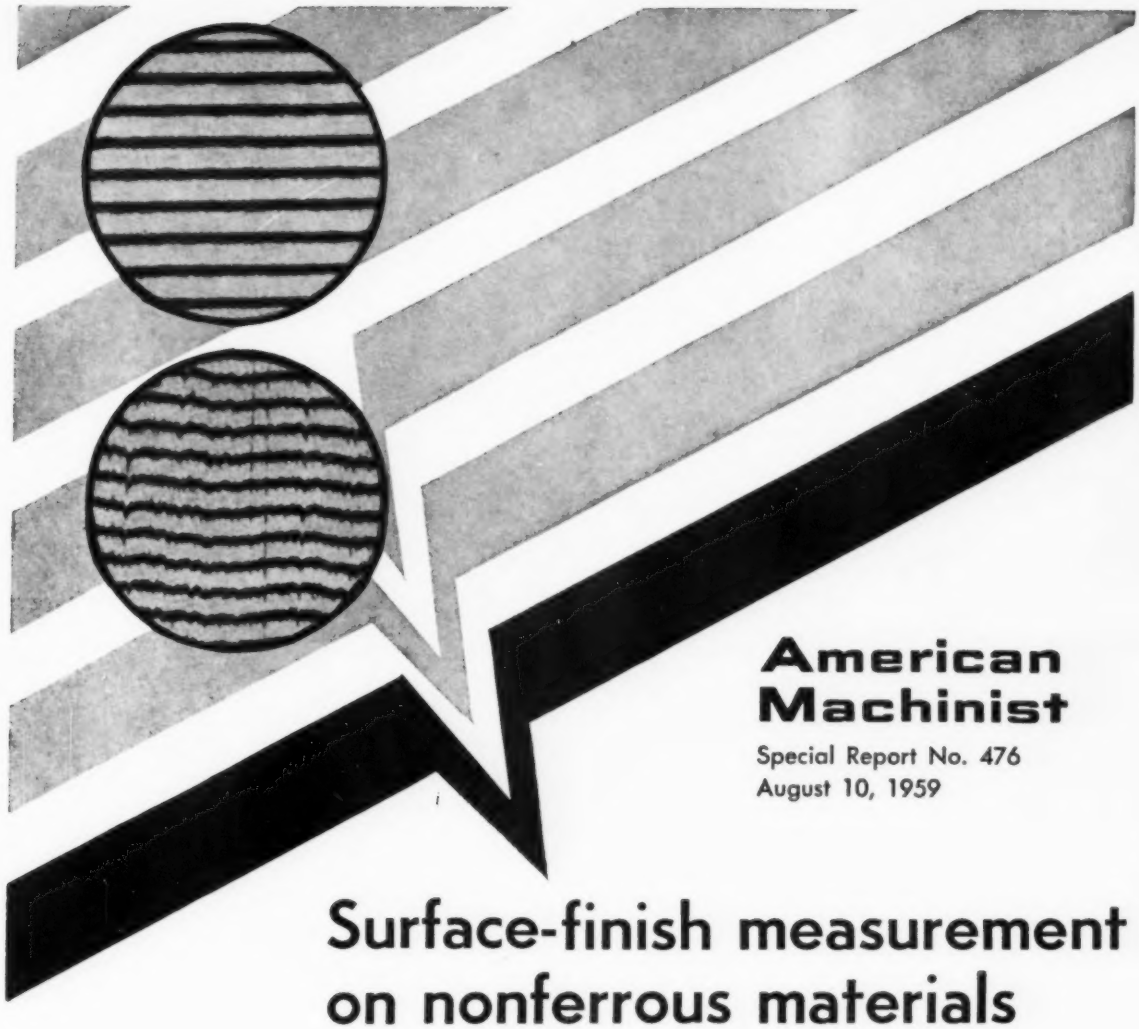
Since a uniform amount is sprayed between each cycle, the company saves about one half of the lubricant formerly used. Three presses require only 36 gallons of the graphite, water-soluble lubricant, mixed with three parts water, during an eight-hour shift.

Die life has improved, too. Now each die produces 13,000 forgings before it is worn.

Better parts with more uniform quality have been achieved with lower labor costs, since the extra men previously needed for hand lubrication could be released for more productive work elsewhere in the Buick plant.



Three-stage forging operation . . .
is complicated by the extreme metal displacement required to fill the die. Here, good lubrication is a must. Trimming (at right) is a separate process



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Surface-finish measurement on nonferrous materials

This report evaluates present-day commercial instruments and surface-finish standards on the basis of what they do and how well they do it

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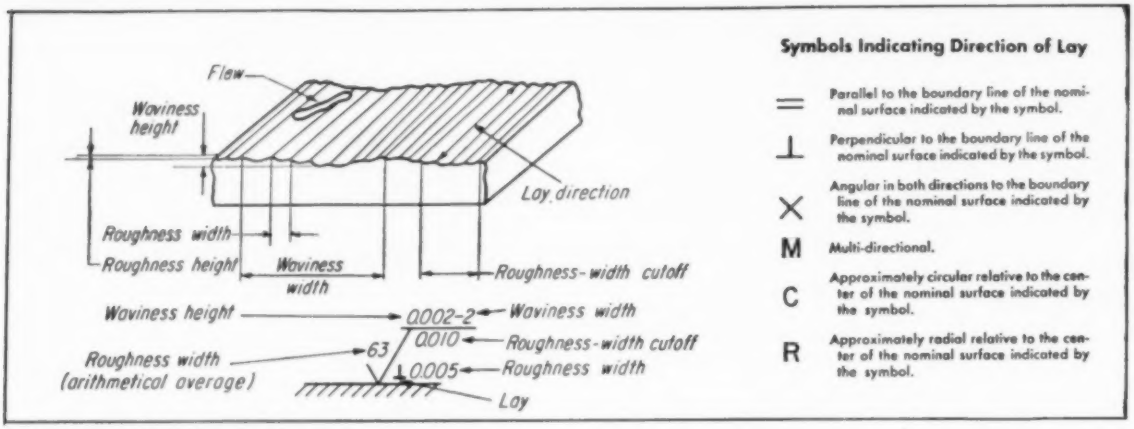
Rapid advances in design and manufacturing techniques, coupled with the increased use of new materials, create many problems for the engineer. Many of the problems are new and require novel approaches — explosive forming, electron-beam welding, etc. And many of the old problems grow more difficult. In this area we have the increasing need for closer control of surface quality.

There are still many surfaces—non-working surfaces such as the walls of a crankcase or a differential housings—that require little, if any, control over their surface finish. But working surfaces—pistons, bearings, instrument parts, gears — require close control. Here at the Allison Division of General Motors, we are engaged in the production of jet and turboprop aircraft engines, and surface finish is quite important. Some parts must provide good bearing surfaces for high-speed shafts and rotors; others must have smooth surfaces so as to reduce the thermal effects of high-speed air flow. There are other parts that would develop dangerous stress concentrations if their surfaces were not smooth.

As is common in the aircraft field, many of these parts are made of nonferrous materials—materials that are inherently softer and, therefore, more easily marred than ferrous materials. One particular part will show the problem we faced. One of our aircraft engines has a shaft seal whose sealing surface is composed of pure carbon, graphite and silver. When the specified surface finish of four microinches was checked with a stylus instrument we found that the stylus scratched the surface. The scratch was hardly noticeable under an interference microscope, but when the seal was subjected to engine vibrations, the scratch caused the entire sealing surface around the scratch to disintegrate. This and other tests convinced us that stylus devices were not the best instruments for measuring surface rough-


Flaw
Waviness height
Lay direction
Roughness width
Roughness height
Waviness width
Roughness-width cutoff
Waviness height
.0002-2
Waviness width
63
.0010
Roughness-width cutoff
Roughness width (arithmetical average)
.0005
Roughness width
Lay
Symbols Indicating Direction of Lay
= Parallel to the boundary line of the nominal surface indicated by the symbol.
⊥ Perpendicular to the boundary line of the nominal surface indicated by the symbol.
X Angular in both directions to the boundary line of the nominal surface indicated by the symbol.
M Multi-directional.
C Approximately circular relative to the center of the nominal surface indicated by the symbol.
R Approximately radial relative to the center of the nominal surface indicated by the symbol.

1. Surface-finish characteristics . . . are fully defined in American Standard ASA B46.1-1955. This sketch and the definitions in this report are based on that standard. The complete surface-finish symbol fully specifies the desired roughness, waviness, and lay. Only those ratings required to specify adequately the desired surface need be shown in symbol

ness on finished nonferrous materials.

Here, then, was our problem: Find a way to measure surface finish that is accurate and repeatable, yet suitable to inspecting delicate nonferrous surfaces. In our search for such a method we investigated measuring techniques and instruments, then analyzed the various standard specifications for designating surface finish. Each method and specification was measured against a definite set of criteria. These criteria and the relative ratings are presented on pages 118-119 of this report.

What is surface roughness?

Before we look at instruments and techniques, it would be wise to review just what it is we're going to measure. Fig. 1 points out all the essential elements of surface finish. The sketches and the following definitions relating to them are taken from American Standard ASA B46.1-1955, "Surface Roughness, Waviness and Lay." An understanding of these basic terms will make the rest of this report more meaningful.

Roughness — Relatively finely spaced surface irregularities, the height, width, and direction of which establish the predominant surface pattern. These irregularities are produced by the cutting tool and the machine tool feed. Height is measured in microinches arithmetical average (one microinch equals one millionth of an inch). The width is rated in inches.

Waviness—Irregularities of greater spacing than roughness. They may result from machine or work deflections, vibration, heat treatment, etc. Height is rated in inches as the peak to valley distance. Width is rated in inches as the spacing of adjacent waves.

Roughness-width cutoff—The maximum width in inches of surface irregularities to be included in measurement of roughness height.

Lay—The predominant direction of the surface pattern. This is normally determined by the production method.

Flaws—Irregularities that occur at one place, or at relatively infrequent intervals in the surface, e.g., a scratch, ridge, hole, peak, crack or check.

With a clear picture of what it is we are trying to measure, we can now analyze the many methods and instruments that are used to measure and/or evaluate surface finish. At first glance it is hard to see any common characteristics among these many techniques. But it is possible to group them into **three different classes: qualitative methods—those which average all the surface characteristics to yield a qualitative evaluation of surface finish; single-parameter methods—those which accurately measure one, sometimes two, surface characteristics; and multiple-parameter methods — those which accurately measure all the surface characteristics.**

Qualitative measurements

In the early days of surface-finish measurement the most commonly used methods involved an examination of surface quality. Crude though these techniques may have been, the principle behind them was good, in that the entire surface condition was considered, not just a single dimension.

Qualitative methods of surface-finish measurement range from visual comparison of the workpiece with a specimen block of known roughness, to instruments that measure how a surface will react under simulated working conditions. **Accuracy of these methods depends largely on the experience and opinion of the inspector, and a broad evaluation of surface condition is about the most one should expect.**

For many applications, however, this may be adequate and, in some cases, even better than an accurate measurement of microinch height. Now, let's look at some of the qualitative measuring techniques used in industry today.

Visual comparison

Judging surface finish by comparing (by eye or by touch) the workpiece with a **specimen block of known surface roughness** is one of the oldest tests of surface quality. Usually these standards are small blocks or cylinders, made of the same material and finished by the same methods as the part to be inspected.

Several companies make sets of specimen blocks for surface quality control purposes. General Electric's specimens consist of a series of ten, flat, electrodeposited replicas with average (RMS) microinch values of 4, 8, 16, 32, 63, 125, 250, 500 and 1000. Norton specimens are eight steel cylinders with roughnesses of 1, 2,

4, 8, 16, 32, 63 and 125 microinches RMS. Boneham & Taylor, an English firm, supplies finish specimens in the form of six graduated plug gages. Fig. 2, reprinted from ASA B46.1-1955, shows typical surfaces for roughness comparison specimens.

Another technique involves the examination of a replica of the work surface. In the **Faxfilm method,** a thin piece of cellulose-acetate film, known as Faxfilm, is impressed upon the work surface. When removed from the work, the film contains an exact, inverted pattern of the surface. This replica is then compared with a replica from a standard finish specimen in a 30X magnification projector.

Microscopic comparison

Because of the magnification of the image, simple microscopic comparison can provide a more accurate measure of surface finish than straight visual comparison. Several instruments are available. The **Bausch & Lomb Surface Comparator,** a small, battery-powered, 10X magnifier, weighs but 8½ ounces and is easy to operate. A set of standard specimen blocks, ranging from 2 to 50 microinch roughness, is supplied for comparison purposes. When compared under the microscope, both the standard and the work surface are illuminated and appear in the same field of view. The **Leitz Surface Comparator Microscope** is a similar, but larger, instrument offering adjustments for magnification, intensity of illumination, and angle of light incidence.

Somewhat different in principle, the **Hilger & Watts Scratch Investigation Microscope** projects the shadow of a straight line onto the surface to be inspected. Because of the roughness of the surface, this shadow, when viewed through the microsope, is no longer a straight line, but a broken line showing peaks and valleys of the surface. The objective lens of the instrument is imprinted with a linear scale that enables the inspector to measure scratch depth or width. Least count is 0.005 in. on the horizontal scale, 0.001 in. on the vertical.

Photoelectric devices

The reflection of light from a finely finished metal surface can be used as a measure of surface finish. Most of the instruments designed for this purpose incorporate a light source that is sharply inclined to the test surface, a photocell, and a meter to indicate the change in current or voltage caused by the roughness of the work surface. When a beam of light is projected upon a surface, the reflected light that can be focused on one spot depends upon the irregularities on the surface which cause scattering of the reflected rays —the rougher the surface, the less the light that can be refocused.

The National Bureau of Standards has developed two photoelectric instruments, a **Glossmeter,** Fig. 3, and a **Surface Replica Analyzer.** The latter oscillates a wax or cellulose replica of the work surface between a light source and a photocell. Variations in surface roughness cause the light intensity reaching the photocell to vary; this in turn affects the current generated in the photocell circuit, and it is this variation that is used as a measure of surface roughness.

Semi-conductor devices, such as Kodak's lead-sulfide **Ektron Detectors,** may, upon further investigation, prove practicable for use in glossmeters. Originally designed as a pickup element for a missile tracking instrument, the Kodak device is available in sizes from 0.5 x 0.5 mm to about 20 x 10 mm, and can be substituted for photocells in many applications. It has high sensitivity to visible light, but for measurement purposes it would probably require an optically amplified light signal.

Because of the varying degrees of reflectivity shown by the various colors and non-homogeneous compositions encountered in nonferrous materials, reflection-type photoelectric instruments could be misleading when used to measure surface finish of nonferrous pieces. For ferrous pieces, however, these devices are extremely sensitive to small changes in surface finish, especially on finely finished work.

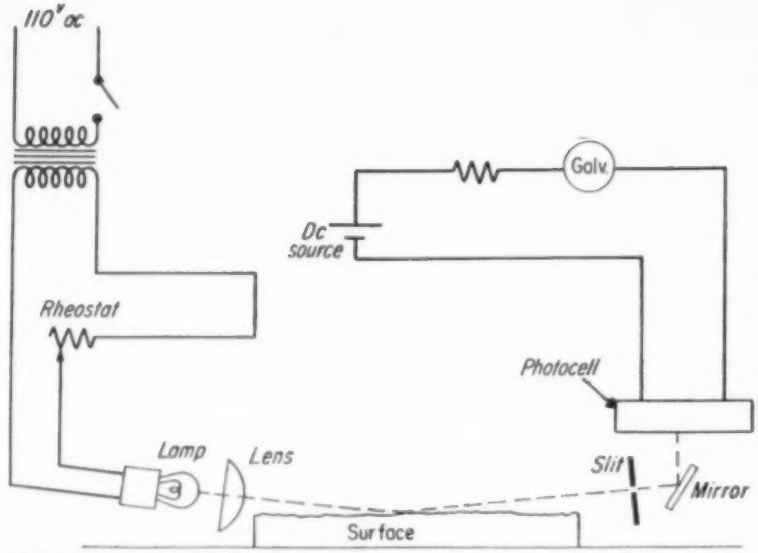
Illumination comparison

Surface reflectivity of a workpiece can be compared directly to that of a standard surface in instruments such as the **Leitz Comparison Microscope.** This instrument is equipped with two independently variable, flashlight-bulb light sources; one to illuminate the workpiece, the other to illuminate a standard surface. Light intensity is varied through a rheostat. Before any comparisons can

Physical Specimens of Surface Roughness and Lay

Type of Surface	Roughness Height (Microinches)	Lay	Feed (Inches)	Minimum Roughness-Width Cutoff (Inches)
Honed, lapped or polished	2	Parallel to long dimension of specimen	—	.030
	4		—	.030
	8		—	.030
Ground with periphery of wheel	4	Parallel to long dimension of specimen	—	.030
	8		—	.030
	16		—	.030
	32		—	.030
	63		—	.030
Ground with flat side of wheel	4	Angular in both directions	—	.030
	8		—	.030
	16		—	.030
	32		—	.030
	63		—	.030
Shaped or turned	32	Parallel to long dimension of specimen	0.002	.030
	63		0.005	.030
	125		0.010	.030
	250		0.020	.100
	500		0.030	.100
Side milled, end milled, or profiled	63	Circular	0.010	.030
	125		0.020	.100
	250	Angular in both directions	0.100	.300
	500		0.100	.300
Milled with periphery of cutter	63	Parallel to short dimension of specimen	0.050	.300
	125		0.075	.300
	250		0.125	1.000
	500		0.250	1.000

2. Roughness comparison specimens . . . provide precision machined surfaces of various roughness against which a work surface can be compared visually or tactually. Most specimens present properties similar to those listed here. Specimens may be machined surfaces or, more commonly, replicas



3. Glossmeter uses photocell . . .
to measure the light reflected from the machined surface. Though very sensitive to small changes in fine finishes on ferrous parts, photoelectric instruments can be misleading when used on nonferrous, non-homogeneous materials

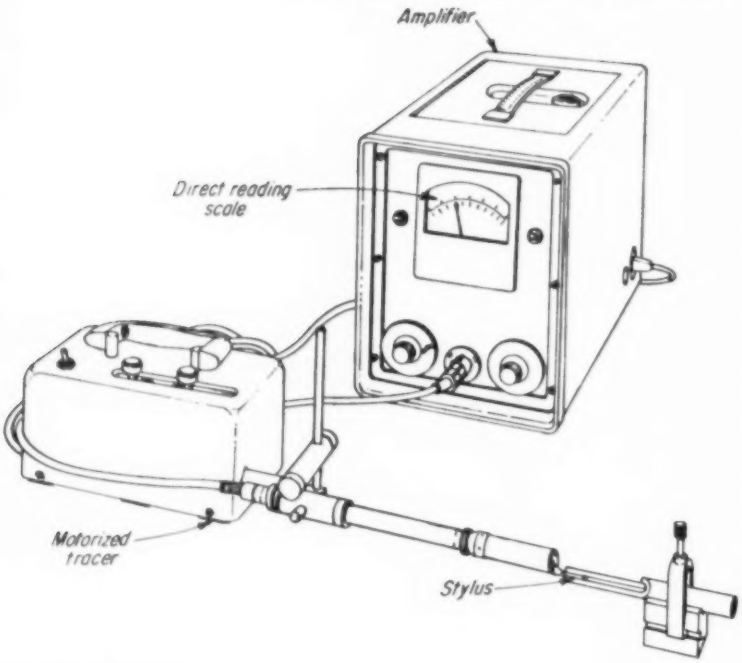
be made, the rheostat must be calibrated so that rheostat setting is proportional to roughness height. This is done by inserting a black flat in one side of the instrument and various standard finish specimens in the other, then varying the illumination on the specimen blocks until the illumination is equal on both sides. Checking surface roughness becomes a simple matter of inserting the black flat, illuminating it to the same degree as in the calibration run, then inserting the workpiece in the other side and varying its illumination until both the black flat and the workpiece surface show the same reflectivity.

To check the effectiveness of this technique on nonferrous materials, five nonferrous parts, the surface finish of which had recently been measured on a Talysurf stylus instrument, were checked in the Leitz microscope against a black flat (Fig. 4). A second test run was made against a white flat; these measurements are also tabulated. Observational error was probably responsible for most of the difference between the readings on any given test piece. Nevertheless, the readings (with one obvious exception) are representative of the stylus readings. Illumination by monochromatic light might further refine this technique.

Air gaging

Air gages are commonly used to check workpiece dimensions; the same basic technique can be used to indicate the surface condition of the piece. In such devices compressed air is fed through a probe which has an annular orifice that is in contact with the work surface. The

Single-parameter instruments . . .



5. Stylus instrument . . .
measures the average roughness height by amplifying and averaging the vertical motions of the stylus as the latter is drawn across the surface of the work. Some stylus instruments provide direct meter readings; others chart the surface profiles

Single-parameter descriptions of machined surfaces are quantitative rather than qualitative and, except for spot checking of mass-produced parts, are usually the preferred method of evaluating surface finish. As the generic term implies, **instruments of this sort measure one (sometimes two) surface characteristic, usually the roughness.** Roughness, as was previously pointed out, consists of the irregularities produced by cutting edges and machine tool feed as a part is machined. **This is measured as a single dimension, the numerical value of which is known as roughness height or, in most cases, average roughness height.**

Though it is a good index of surface condition, in that it compares the actual surface profile with that of a theoretical flat surface, average surface roughness is far from being an indication of total surface condition. In other words, roughness does not tell the whole story. Surface flaws—porosity, heat checks and cracks, and surface non-homogeneity, in the case of nonferrous materials—may go unnoticed. Sometimes these factors can outweigh rough-

amount of air escaping from between the orifice and the surface will depend upon the roughness of the surface, and the back pressure created as more or less air escapes can be used as an indication of surface roughness. A simple water manometer can serve as a differential pressure gage in such a system.

The **Sheffield Corporation** has developed an instrument in which the probe is built into a granite surface plate. As the piece is moved over the plate and probe, the instrument indicates the average surface condition. A French instrument, the **Solex air surface gage**, is based upon the same principle but is more portable and has special devices for measuring bore and groove surfaces. These instruments give indications of surface bearing condition; they cannot indicate the type and number of flaws per unit area, nor can they differentiate between roughness and waviness.

Surface-quality devices

Several attempts have been made to design practical instruments that will measure how well a surface will react under simulated working conditions, but only one seems important enough for consideration. This is the **Surface Finish Recording Dynamometer**, in which the part to be tested (usually a journal bearing) is subjected to the sliding action of weights attached to a pendulum. As the pendulum swings, a mechanical linkage connected to it feeds out a narrow paper tape; the length of tape fed out before friction brings the weights to a halt is a measure of the frictional characteristic of the bearing.

Bearing surface quality can also be determined through actual trial runs of the bearing assembly. These are expensive and time consuming, especially since they must be repeated every time some component of the bearing assembly is modified.

Workpiece material	AA Roughness, μ-in.		
	Talysurf	Leitz Comp. Microscope	
		Black flat	White flat
Carbon (seal)	4	4	0
Aluminum	38	32	16
Magnesium	27	16	20
Brass	38	20	16
Bronze	40	40	4

4. Illumination comparison . . . compares the reflectivity of a machined surface with that of a standard surface. Test surfaces were first checked on a Talysurf stylus instrument, then compared with a standard in the Leitz Comparison Microscope

provide quantitative measurements

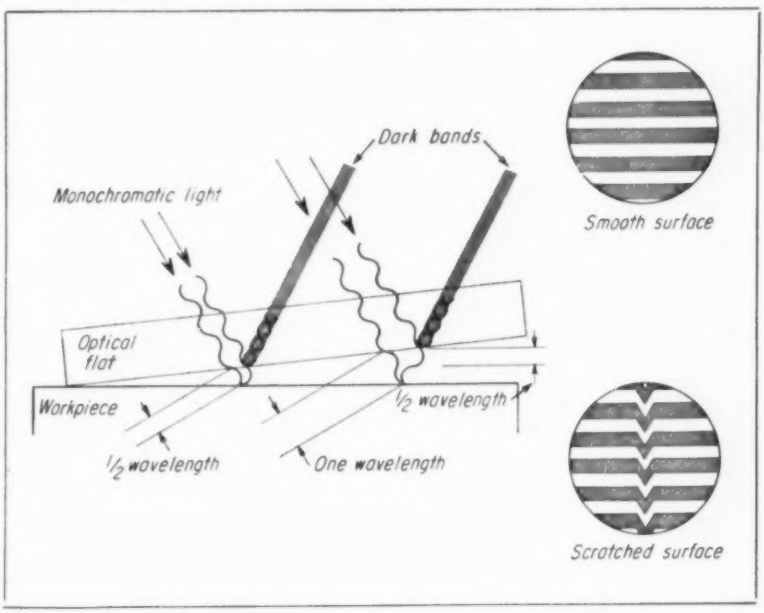
ness in their effect on the functioning of the finished part.

Instruments providing single-parameter measurements can be classified as stylus (or tracer) instruments and optical instruments. The former measure average roughness height; the latter, total roughness height.

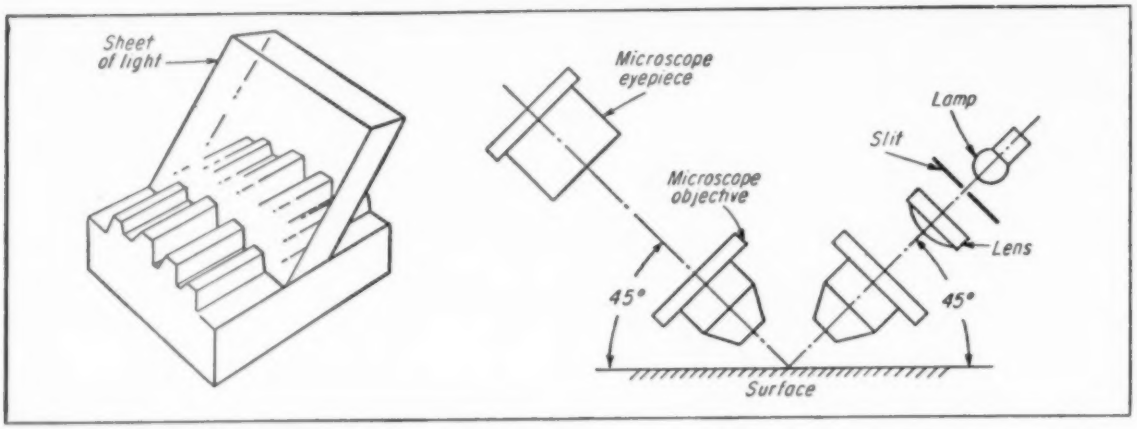
Stylus instruments

The most commonly used instrument for surface-finish measurement is the stylus instrument, Fig. 5. The method is basically simple. A fine stylus (0.0005-in.-radius tip is standard) is drawn over the surface to be measured, and the vertical motions of the stylus are amplified and recorded, or measured by an averaging instrument, to indicate the profile traced by the stylus.

Of the many stylus instruments available, the **Profilometer** and the **Surfindicator** find the widest use in production surface inspection, mainly because they are simple, economical and accurate, yet rugged enough to be unaffected by outside vibrations. The Profilometer, which can be used with motorized or manual tracing, provides a choice of meas-



6. Optical interference measurements . . . depend upon the phenomenon of destructive interference of light waves. As shown in this exaggerated sketch, a dark interference band occurs wherever the distance between the bottom of the flat and the work surface is equal to one half-wave length of the incident light, or some multiple thereof. Sketches at right show how a scratch disrupts pattern—the amount of deviation is a measure of the scratch depth



7. Light-section (45°) microscope . . .
projects a sheet of light onto the surface and, in effect, provides the viewer with a section view of the surface pattern. A reticle in the microscope can be shifted to measure the height or width of the surface irregularities

uring ranges, with a maximum reading of 1000 microinches AA. It has a standard stylus point and bears on the surface with a force of two grams. This instrument can also measure RMS roughness height.

The Surfindicator also measures average roughness. Like the Profilometer, it has a standard point and affords a maximum measuring range of 0 to 1000 microinches AA, and is generally used with a motorized trace. Stylus pressure is only one gram.

Two other stylus instruments, though not as widely used, should be mentioned. The **Model 100 Talysurf** has a maximum reading of 200 microinches, a stylus tip radius of 0.0001 in., and a stylus pressure of 0.3 gram. The **Leitz Roughness Tester,** a smaller but similar instrument, permits the pickup head to be placed directly on the work surface. This is especially useful for inspecting parts that are too large to be placed on a platform, as is the practice on most other stylus devices. Total range of this tester is 0 to 2000 microinches, tip radius is 0.0006 in., and stylus pressure is one gram.

To repeat, these devices do not measure total surface condition; they do not indicate whether the surface is homogeneous, nor do they give us information on the number and type of flaws present. This is an important factor in checking such items as bearings, where small flaws could collect dirt and tiny bits of metal, and thus seriously lower the life of the bearing. Nor do stylus devices differentiate between roughness and waviness patterns, though the establishment of a roughness-width cutoff (the maximum width of irregularities to be included in measurement of roughness height) has simplified the evaluation of roughness readings.

Working with nonferrous materials introduces another problem—stylus pressure. Pressures of 0.3 to two grams may seem negligible, but they are not. Consider a test performed on the sealing surface of a carbon shaft seal that is used in our turboprop aircraft engine. Checked with a **Model 3 Talysurf,** a laboratory instrument with a stylus tip radius of 0.0001 in. and a stylus pressure of only 0.1 gram, the carbon surface showed a scratch about one microinch deep, a penetration scarcely noticeable in the interference microscope. But this scratch caused disintegration of the surface under severe engine vibration.

Bearing materials such as brass and bronze present a similar problem, but to a less critical degree. Such a scratch would, nevertheless, permit dirt to gather.

Other experimenters report that an aluminum sample was minutely scratched by a stylus with a tip radius of 0.0001 in. and a stylus pressure of only 0.006 gram. Scratching of the surface, a characteristic of all stylus instruments, is a serious drawback in the measurement of surface finish on nonferrous materials. Yet these same devices have played the major role in the advance in surface quality evaluation during the past thirty years. **Used with an appreciation of their limitations, stylus instruments should continue to be the preferred instruments for spot checking roughness of finely finished ferrous workpieces.**

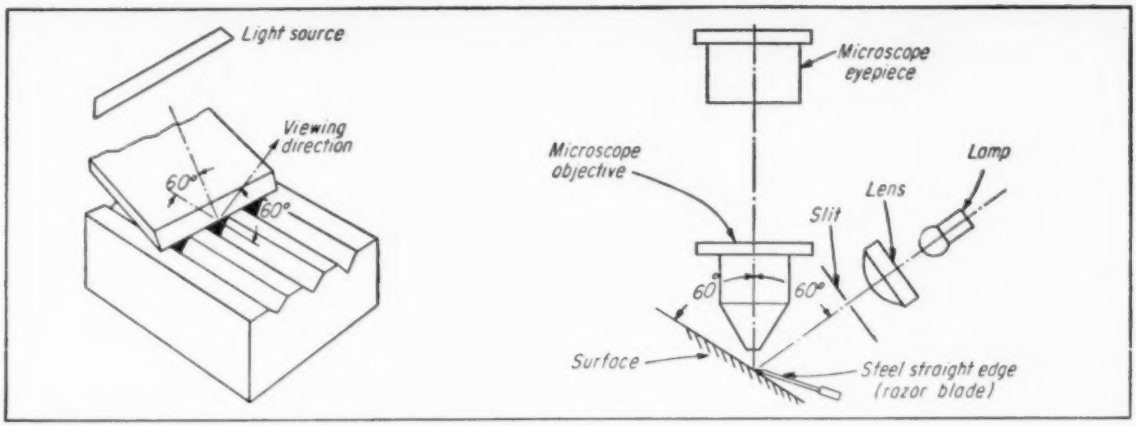
Stylus devices are being improved constantly. Manufacturers are aiming for greater range, greater accuracy, and more versatility.

Optical instruments

The simple microscopes previously discussed only magnify the image of the surface; they do not permit actual roughness measurement. Fortunately, there are several optical devices that do. These are the interference microscope, the optical-cut (or 45°) microscope, and the blade-edge (or 60°) microscope.

Before attempting to describe the interference microscope, a short explanation of optical interference, the phenomenon which makes such an instrument possible, seems in order. Consider Fig. 6: If an optical flat is pressed against an edge of a flat workpiece so that a wedge of air (highly exaggerated here) is created between them, and the flat is then illuminated with monochromatic light, we will see a series of alternating light and dark bands. If the workpiece is perfectly flat these bands will be straight and parallel. **This phenomenon is caused by optical interference, and the dark bands are known as interference bands.** What causes the bands? Look at the rays striking the flat. Each light ray is split in two parts by the flat. One part reflects from the lower surface of the flat; the other part from the work surface. The dark bands occur wherever light reflected from the work surface interferes with light reflected from the under-surface of the flat. This occurs wherever the distance between the reflecting surfaces is equal to the half-wave length of the incident light or some multiple thereof—½, 1, 3/2 etc.

Because the wavelength of monochromatic light is uniform and can be accurately measured, the height differences can be calculated from



8. Blade-edge (60°) microscope . . . throws the shadow of a straightedge onto the work surface to permit surface roughness measurement. This instrument requires a perfectly smooth straightedge for true readings. Both the 45° and 60° microscopes are easy to use and leave no mark on the work surface

the distances between the interference bands.

A machined surface, of course, will not be perfectly flat; it will have a great many peaks and valleys as a result of the machining process. The same optical principle can be applied to measuring such a surface—though in this case we are actually interested in measuring the depth of the valleys. Fig. 6 also shows how such a groove or scratch will disrupt an interference pattern. Scratch depth can be found by multiplying the band deviation (in fractions of band spacing) by the half-wave length of the light used. Now, to the instrument itself.

Interference microscope

The principles just discussed have been incorporated into several different interference microscopes, the differences being mainly in the optical design. Most of the instruments separate the optical flat and the work surface and compare the two through an optical system. This affords versatility in magnifications and in the methods of staging, or setting up, the workpiece.

Five instruments will be discussed: the Surface Finish Microscope and the Surface Finish Micro-Interferometer, both made by Hilger & Watts; the Interference Microscope and the Interference Surface Tester, both made by Zeiss; and the Multiple Beam Interferometer made by C E Johansson.

The **H&W Surface Finish Microscope** uses a mercury-vapor lamp that throws light through an adjustable diaphragm to a 50%-reflecting surface. The light is, in turn, reflected through an objective lens and a small optical flat that rests on the part to be measured. The light reflects back through the 50%-reflecting surface to the eyepiece, where an interference pattern is observed. Like most interference instruments, it is limited to measuring the finer surfaces, in this case 20 microinches. Above this roughness, the pattern is difficult to interpret.

Made by the same company, the **Surface Finish Micro-Interferometer** offers three magnifications and three comparison flats that can be interchanged to give different degrees of reflectivity. Surfaces up to 40 microinches can be measured, using either monochromatic or white light. White light, as an interference medium, has one advantage over monochromatic light—the pattern is composed of all the colors of the white-light spectrum but only the center line is completely black. Thus it is quite easy to trace this line from a crest to a valley. Monochromatic light, however, is more accurate for measuring because of its uniform wavelength.

The **Zeiss Interference Microscope,** providing magnifications of 80, 200 and 480X, is a compact instrument that can handle a wide range of parts. It is capable of measuring surface irregularities of 1.2 to 80 microinches, and is equipped with both monochromatic (thallium) and white light sources. When band deflection is greater than band spacing it is easier to trace the lines with white light illumination, but the thallium light is always used for measurement.

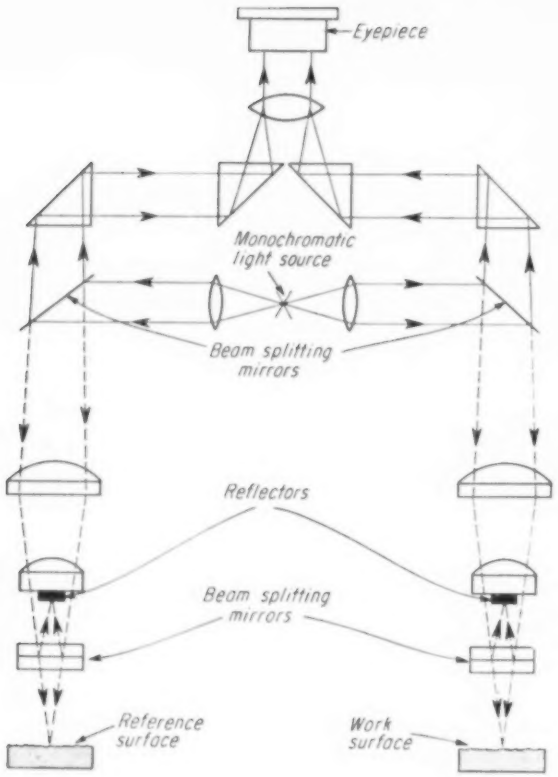
Zeiss also makes the **Interference Surface Tester.** It uses monochromatic light only, and is designed so that it can be placed directly on parts that are too large to be staged in the ordinary interference instrument. (The manufacturer prefers to restrict this instrument to flatness inspection.)

Multiple-beam interferometers of the type manufactured by Johansson provide interference patterns of high contrast, making it easier to measure the finer irregularities on a surface. Multiple-beam interference is brought about by reflecting a monochromatic light beam back and forth between two half-silvered mirrors. Measurements as fine as 0.04 microinch on glass and 0.2 microinch on metal have been recorded with this type of instrument.

There is no doubt about the inherent accuracy of interference instruments. Most of them, however, are expensive, delicate, and fairly complicated to operate, though some of the later models are much simpler. And, in general, most of them are designed for laboratory, rather than production, testing. For measurement of surface finish on nonferrous materials, though, these devices have much to recommend them—they do not mar the surface, they can detect heterogeneous surfaces and evaluate them, and most of them can provide permanent records of the interference patterns through photographic attachments. **For fine surface finishes they are excellent; but when irregularities exceed 70 or 80 microinches the interference pattern becomes difficult to evaluate.**

Other microscopes

Two other optical instruments find wide application in measuring surface finish. One is the **optical-cut microscope,** Fig. 7, originally designed by Prof G Schmaltz, a Ger-



9. Superimposed-interference instrument . . .
could project the interference pattern of the work surface and that of a specimen block of acceptable roughness to a common eyepiece for direct comparison. No such instrument now exists; it is one of several proposed as a result of the investigations conducted for this report

man, and now available in several designs. It is also known as the 45° microscope and as the Light Section Microscope. In the Zeiss instrument, an incandescent lamp illuminates a slit which is reproduced on the work surface as a fine band of light. This band of light traces out the profile of the surface—its peaks and valleys. A reticle in the microscope can be shifted within the field of view to measure the height (or the width) of the surface irregularities. The reticle is set in such a way that the horizontal crossline is tangent first to the peak and then to the valley of profile image. Depth of roughness is the difference between the two readings on the measuring drum of the microscope. Roughness and waviness width are determined in a similar way with the vertical crossline. Of course, these measurements can be determined from photos taken through the microscope. The latest Zeiss model permits measurements from 1 to 400 microinches in four ranges, and can be supplied with a Zeiss camera attachment.

The **blade-edge, or 60°, microscope,** Fig. 8, throws the shadow of a straightedge (razor blade) on the work surface by means of a light placed at 60° to the surface. The microscope element is mounted at 60° to both the light source and the work surface. This provides maximum illumination and gives identical vertical and horizontal magnification. Obviously the blade edge must be perfectly straight; any nick, scratch or flaw would cause an irregular shadow and lead to entirely false readings.

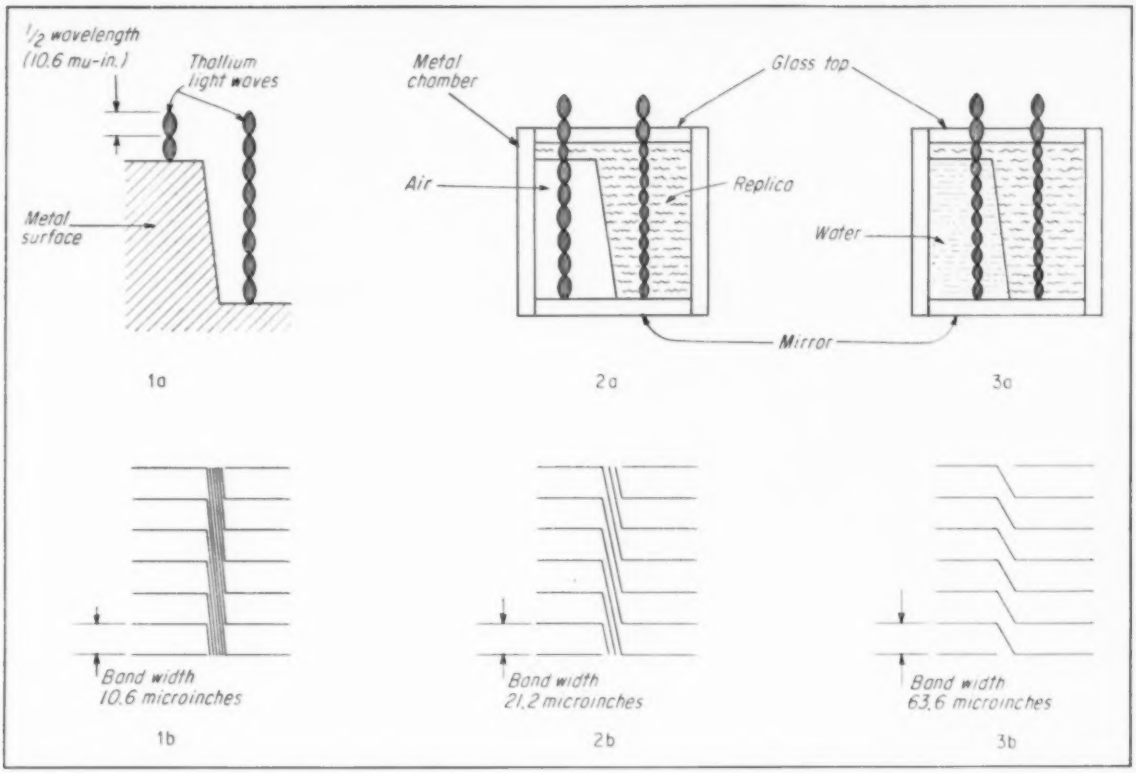
Advantages of these microscopes should be quite evident—they do not mar the work, the range is greater than that of the interference microscopes, they are simpler to use and are less expensive. Their optical design, however, permits the examination of only a short length of the surface at any one time.

There is no reason why these methods, particularly multiple-beam interferometry and the 45° microscope, could not be used in conjunction with other methods to evaluate total surface condition. For instance, the multiple-beam interferometer or the interference microscope could be reserved for inspection of finishes from 0 to 40 microinches, and the 45° microscope could handle measurements in the range from 40 to 400 microinches or even higher. This combination would afford high accuracy where it is needed, as well as speed where accuracy is not as essential. The interference instruments, most of which have provision for white light magnification without the interference bands, could also be used as the surface porosity and flaw inspection devices. They have the accuracy and repeatability needed for definite surface finish evaluation.

Further investigation

Why couldn't some of the existing inspection instruments be combined to make a new and better instrument for measuring surface finish? The first combination we considered would combine the accuracy of the interference microscope with the clarity and readability of the optical comparator. The interference bands, instead of being viewed through the microscope, would be projected upon the comparator screen. Plastic overlay charts with lines representing roughness limits would simply be placed over the interference pattern to determine whether or not the finish was acceptable. The charts would have to be keyed to the magnification of the instrument and to any tilting of the workpiece or comparison mirror. If feasible, such an instrument should reduce observational errors. One stumbling block in the development of such a device might be the intensity of monochromatic light necessary for projection over the long distance involved.

Further consideration of the interference microscope led to the idea of combining it with the comparison microscope. In such an instrument interference patterns would be projected to a common eyepiece, as shown in Fig. 9. One pattern would be that of a reference surface of acceptable finish; the other, that of the surface being checked. Direct comparison with the reference pattern would show whether or not the workpiece surface was acceptable. Confusion as to which pattern is which can be eliminated by moving one of the surfaces back and forth and noting which of the patterns shifts.



10. Interference patterns are easy to read . . . if you can trace a single band from peak to valley. The surface represented in 1a would yield a pattern like that in 1b, where it is almost impossible to follow a single band. The Zehender technique, illustrated in 2a, 2b and 3a, 3b, artificially spreads out the dark band groupings and makes for easy, accurate measurement. Dr Zehender's technique is explained in the text

Multiple-parameter measurements

Roughness is but one characteristic of a surface. Many other factors influence the quality of a finished surface—the form, slope or wavelength of the roughness profile curve, the ratio of bearing contact area to total area, surface waviness, flaws, etc. Instruments that measure roughness plus these other surface finish parameters provide a multiple-parameter description of the surface. They give not only a "magnitude" factor but a "form" factor as well, and in this way permit a more thorough evaluation of surface quality.

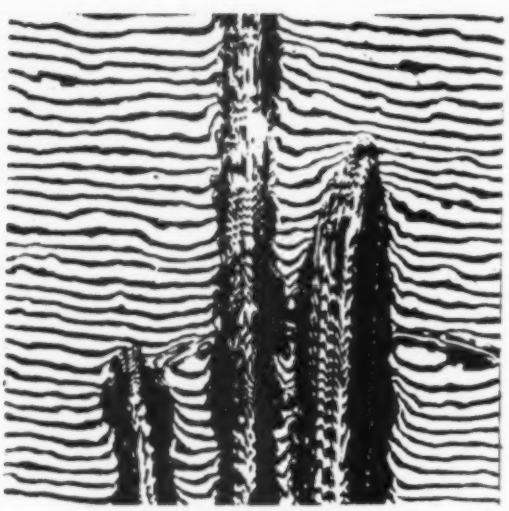
Replica methods

Many surfaces which must be checked are nearly inaccessible. It would be impossible to get a microscope into a bore or a casting core hole, and it is difficult to get at the lower surfaces of gear teeth. We can't bring the instrument to the work surface, but we can bring the surface to the instrument—in the form of a wax or lacquer impression of the surface. These replicas are easy to make and, when done carefully—as they must be—they exhibit the same topographical characteristics as the original surface, but in an inverted form. This technique is also quite useful in examining surfaces of parts that are too large for staging on interference or 45° microscopes.

This replica technique has an extremely useful application in interference measurement. **Perhaps the greatest limitation on the use of light interference for surface finish evaluation has been the very close grouping of the dark bands when the roughness height gets to be 80 microinches or more. Such a pattern defies accurate interpretation. Recently, a German scientist, Dr Zehender, developed a simple technique for artificially spreading these band groupings on rough surfaces, without affecting the accuracy of measurement.**

The **Zehender technique** can best be explained by referring to **Fig. 10,** a schematic illustration of the principle. The first sketch, 1a, depicts a cross-section of a machined surface with monochromatic light falling upon it as it would in an interference microscope. As we can see, peak-to-valley height is six half-wave lengths. Sketch 1b, immediately below, represents the interference pattern for this surface condition. The pattern is difficult to read because the dark band groupings are too close together. Actually, the band deviation is six band widths, giving us a 6 x 10.6 x 10^{-6} or 63.6-microinch groove depth.

Dr Zehender found that he could spread these dark band groupings by using a transparent surface replica that had a refractive index higher than that of air. Sketch 2a shows a wax replica (refractive index of 1.5) contained in a hollow steel chamber that has a clear glass top and a quartz mirror on the bottom. This chamber is staged on the microscope in the



a. direct interference

b. replica pattern

11. Interference pattern photographs show the effect of the Zehender band-spreading technique. All four photos are of the same scratch pattern. The central scratch is 120 microinches deep, beyond the range of the interference microscope. The direct

same way as an ordinary metal specimen. When the thallium light passes into the wax, its wavelength is shortened by a factor of 1.5 so that, for the same peak-to-valley height as in the first sketch, we now have nine half-waves passing through the replica, but only six half-waves passing through the air. This, of course, changes the interference pattern. In sketch 2b, we can see that the band deviation is now only three band widths. Since this represents the same groove depth, 63.6 microinches, it is apparent that a one band-width deviation, when using this particular replica material, is equal to 63.6÷3, or 21.2 microinches. The pattern is now easier to read, yet is as accurate as ever.

Further spreading is possible through water immersion of the replica, as shown in sketch 3a. Since water has a refractive index of 1.33, we now have eight half-waves passing through the water in the same distance as nine half-waves pass through the wax replica. The resultant interference pattern, 3b, shows a one band-width deviation. A one band-width deviation, using the same replica material and immersing it in water, represents a groove depth of 63.6 microinches.

Deeper scratch patterns can be resolved by using liquids with higher refractive indexes. Fig. 11 shows photographs of the interference patterns obtained from a surface with a 120-microinch-deep scratch. Sketches *a*, *b* and *c* correspond to the steps just outlined for Fig. 10. Sketch *d* is the interference pattern obtained using a wax replica immersed in oil.

At the same time that he measures surface roughness, the operator can also count the number of surface flaws. And, by combinations of immersion media, he could get separate measurements for roughness and waviness. For very fine surfaces, the Zehender technique can be reversed. A liquid with refractive properties that lengthen the wavelength of the light would amplify the surface irregularities. (Monobrominaphthalene is one of many such liquids. They must, however, be applied directly to the metal surface, not to a replica.)

A combination of the Zehender technique, a systematic parts inspection program, and a simple specification seems to offer the best solution to the problems of measuring surface finish on nonferrous materials.

Profile graphing

Several stylus instruments are designed to provide simultaneous or concurrent measurements of several surface characteristics, recording the topography of the surface on a permanent chart. The chart can then be evaluated for peak-to-valley roughness height as well as average roughness.

The **Model 3 Talysurf,** consisting of a pickup, an amplifier and an averaging meter, amplifies and records the stylus motion on a strip of ruled tape. The marking head is an electrical etching device that is linked electrically to the amplifier output signal.

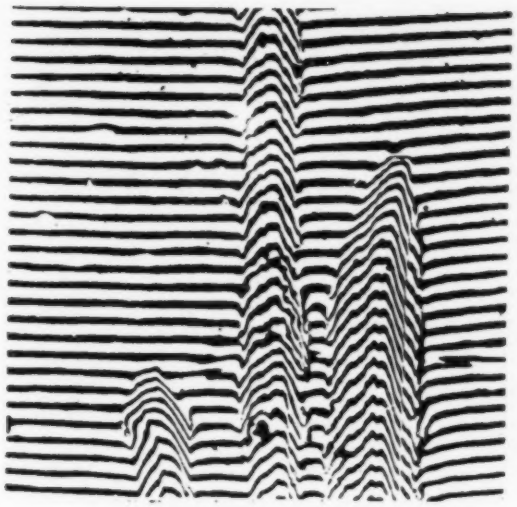
Though basically similar to the Talysurf, the **Proficorder** goes a few steps beyond, providing magnified charts of waviness, roughness, and roughness superimposed upon waviness. In this way we can distinguish the irregularities resulting from machine or work deflections, vibration or heat treatment—which we call waviness—from the irregularities caused by the cutting tool—the roughness.

The **Leitz-Forster Surface Measuring Instrument** differs from the previous two devices in that the stylus, instead of tracing over the surface with a constant velocity, is caused to oscillate vertically at a rate of 50 to 120 cycles per second. The result is a series of very closely spaced punch marks on the surface. A permanent chart is made on film in a camera, the shutter speed of which is synchronized with the movement of the stylus. Positive prints can be kept for reference.

Ultrasonics and radar

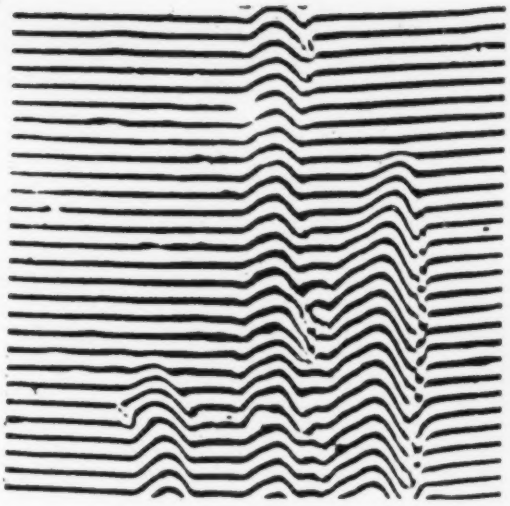
Ultrasonic inspection is being used today to check metallic materials for internal flaws such as cracks and inclusions, and also to measure thickness of metal pieces where only one side is accessible. Could the principle of ultrasonics be applied to surface-finish measurement? And how about its close relative, radar? We investigated both techniques and have evaluated them in the chart on page 118.

In the case of **ultrasonics,** we have found that all the ultrasonic trans-



c. water-immersed replica

interference pattern cannot be read; the replica pattern is somewhat better. Immersing the replica in water spreads the bands



d. oil-immersed replica

sufficiently to allow easy measurement; oil immersion spreads bands further

missions tested to date have readily entered any metallic material, seriously complicating the job of interpreting the returning signals. Further investigation of frequencies closer to the wave transmission speed of light may bring ultrasonic surface finish measurement within the realm of possibility.

Radar is based on the same theory of wave propagation as ultrasonics. The main difference is that ultrasonic waves are usually transmitted through liquid or solid media, while radar transmission is usually through air. Also, the radar pickup employs an antenna rather than a crystal.

Continuous-wave radar systems would seem applicable to surface-finish measurement provided they could meet the following criteria: simultaneous interpretation of a large number of targets; small target-to-antenna distance; low scanning speed; high transmission or modulation frequency; short wave length; and high pulse rate. Our investigations showed that a multiple-target frequency-modulation system could meet such requirements. We have gone no deeper into this matter, but we have shown that radar inspection is not an impossibility.

Multiple-parameter measurements provide the best evaluation of surface quality. Instruments and techniques within this classification, however, vary in their applicability. Stylus instruments, as we have seen, are somewhat destructive when used on nonferrous materials. Both ultrasonics and radar, while not impossible, require extensive research. Such work would be expensive, and the instrument, if one could be developed, would be expensive and quite delicate.

The Zehender replica technique, though not yet tested on a mass inspection basis, appears to be the most suitable of the multiple-parameter methods. One can measure roughness, waviness, lay, flaws and, at the same time, retain a permanent visual record of all surfaces examined. The method is inexpensive, simple, and accurate. Further, it eliminates the confusion that results when heterogeneous surfaces are examined—the replicas are homogeneous and display only the machined surface characteristics and, if present, the surface porosity.

Surface-finish specifications

Instruments for measuring surface topography are many and varied, as we have seen. Yet all are designed to measure a surface finish that is specified by the design engineer as acceptable for the particular piece. How does he define a finish so that other engineers, machinists, and inspectors will know exactly what he wants? He uses standard specifications.

Seven primary methods of defining surface finish are in use today, and all seven are closely related as to the elements of surface topography with which they are concerned. During this study we have devised three other methods and these will also be discussed.

Specifications can be divided into comparison standards—those which are used to compare a theoretically perfect surface with the work surface; direct standards—those which define the various elements of surface topography by words and symbols; and graphic standards—those which define a surface condition in relation to a perfect surface through a formula or a graph.

Comparison standards

These are probably the most economical as well as the simplest surface-finish specifications in common use. Comparison standards consist of surface specimen blocks that are used for visual comparison and surface specimen blocks that are used for instrument calibration. A third type of standard, of our own design, is the profile chart for use with a combined interference microscope-optical projector instrument.

The visual comparison blocks serve a dual purpose—they serve as an instrument for evaluating finish and they act as a comparison standard. As was explained earlier in this report, there are several drawbacks to the use of these blocks as instru-

ments; the same disadvantages exist when they are used as standards. Because the whole range of microinch values is not available in any of the sets discussed, interpolation is often necessary and is rough at best. Then again, most of the specimens are patterned to represent a ferrous or homogeneous surface. Misinterpretation can easily result when comparing the heterogeneous surface structure of a nonferrous part with the homogeneous surface of the specimen block.

All the stylus instruments on the market are supplied with a specimen block for calibration purposes. Calibration is accomplished by tracing the stylus over the specimen of known roughness and setting the instrument accordingly. The grooves are accurately ruled with a diamond stylus to provide a definite microinch finish. Some blocks are replicas of the ruled master and some are original glass masters. Each type of instrument has its own standard, differing in microinch value and method of preparation.

If a calibration block designed for a given stylus instrument is used on a different type of stylus instrument, erroneous readings may be obtained. As part of this investigation, we took standard calibration blocks for the Model 3 Talysurf, which consist of two accurately ruled glass standards of 3.5 and 37 microinches AA roughness, and measured these roughnesses with thirteen different stylus instruments, each of which was first calibrated to its own standard. Fig. 12 shows representative roughness readings obtained (RMS readings were also taken but are not shown here). The maximum deviation from a true 3.5 microinch AA roughness was 1.7 microinches; from the 37 microinch AA roughness, 7 microinches.

Some improvement could be made if all stylus instruments were calibrated to the same standard. By cooperative development, General Motors and Chrysler devised a method for making reproducible physical standards for surface roughness. These five blocks—20, 32, 50, 80 and 125 microinches—permit calibration of any stylus instrument.

Profile charts might have application as standards. Earlier in this report we considered combining the interference microscope and the optical comparator into a single instrument that could use plastic overlay charts to determine roughness (page 112). Our investigation shows that the magnification would have to be 3000X. A plastic chart to check a 4 microinch finish would have lines 0.012 in. apart. If the operator places the limit chart on the screen and then stages the part in the microscope, he would see the interference pattern superimposed on the lines of the chart and could easily determine whether the total roughness height was within limits.

Roughness of → / as read on ↓	Talysurf surface finish standards	
	3.5μ-in.AA	37μ-in.AA
Talysurf	3.5μ-in.	37μ-in.
Zeiss Intf. Micr.	3.5	37
Profilometer	2.8	30
Profilometer	4.5	34
Surfindicator	3.8	37
Surfindicator	5.2	38

12. Roughness measurements vary . . .
when different instruments, all calibrated to their own standards, are used to measure the surface roughness of standard blocks. When surface roughness is specified, the specification should point out which instrument is to be used for measurement

Graphical standards

Both arithmetical average and root-mean-square average surface roughness are based upon a graphical specification. Another graphical specification is the Abbott and Firestone bearing-area curve.

Arithmetical average (AA) and root-mean-square average (RMS) roughness can be calculated from a surface profile as shown in Fig. 14.

Height readings are taken at equally spaced intervals along the mean line. The arithmetical average is the sum of the individual height readings divided by the number of height readings taken. The RMS average is calculated by taking the sum of the squares of the individual heights, dividing this sum by the number of height readings taken, then taking the square root of this quotient.

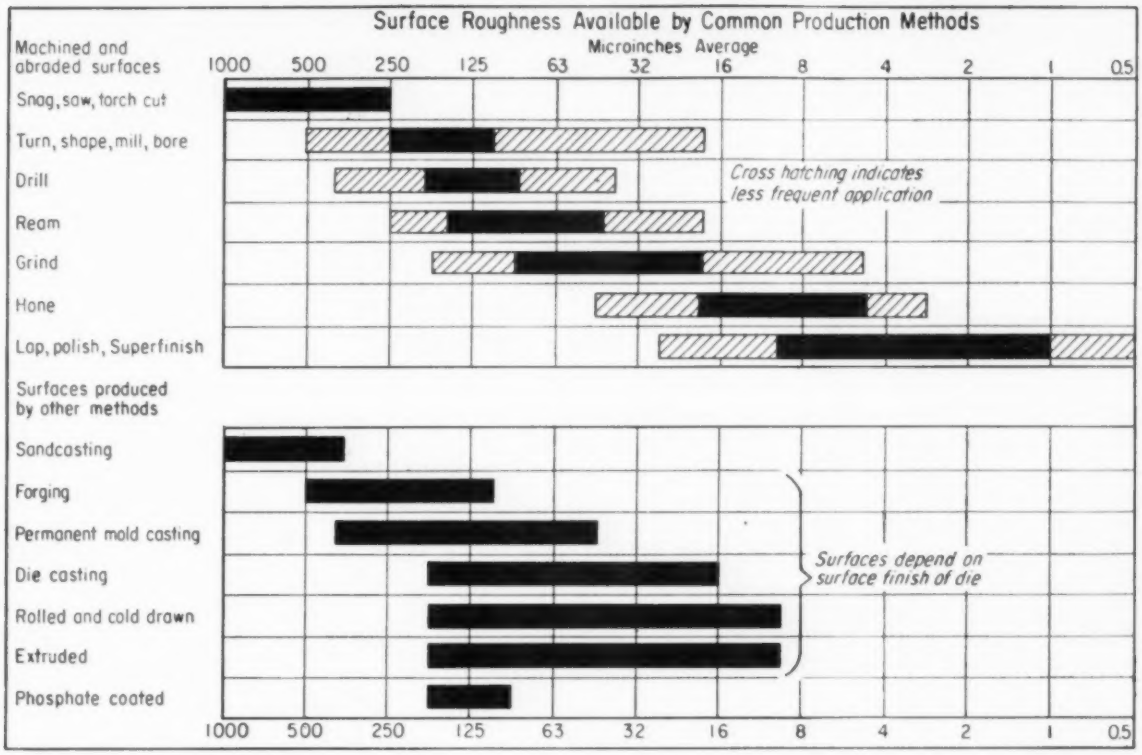
Though RMS average roughness was popular for many years in the United States, it has now been replaced by the arithmetical average. The ASA specification states that roughness shall be in microinches arithmetical average. There were several reasons for the change. First, arithmetical average is easier to calculate and provides an equally good evaluation of the surface. Second, arithmetical average can be determined from a profile chart with a planimeter (an instrument that measures the area under a curve by tracing around the curve). Also, electrical instruments measuring AA roughness can use meters with linear scales. An RMS average current is difficult to measure because of its short duration and its variable wave form.

The **Abbott and Firestone curve,** Fig. 15, p119, describes a surface in terms of a percent of bearing area, showing the relation between a perfectly flat bearing surface and the test surface. The graph is plotted this way: Divide the surface profile trace into horizontal sections as shown, then measure what percent of each horizontal line lies within the profile trace. Line 1, of course, is not cut by the profile (lines 1 and 7 mark the extremes of the profile) and, therefore, plots as zero on the graph. About 26% of line 2 lies within the profile trace, and this figure is plotted on line 2 on the graph. A perfectly flat surface would plot as a horizontal line.

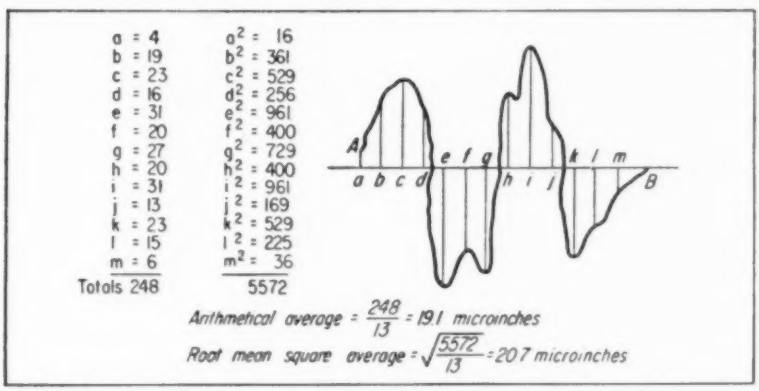
This technique has been used solely for evaluation of bearing surfaces. To extend it to other surface problems—evaluation of surface finishes suitable for parts subjected to high temperature, stress, strain, shock—would necessitate the formulation of a standard, acceptable bearing-area curve for each application.

Direct standards

The direct methods of specifying surface finish are those the design engineer uses on his drawings. Direct standards must convey to the machinist all the information he needs to produce the surface called for by



13. Production methods influence finish . . .
Chart shows typical range of surface finishes that can be achieved by various production methods. **However, small changes in the wheel speed of a surface grinder, for example, can cause quite a change in the finish the grinder can produce. Therefore, the values shown should not be considered hard and fast limits.** Chart is from ASA B46.1-1955


a = 4 a² = 16
b = 19 b² = 361
c = 23 c² = 529
d = 16 d² = 256
e = 31 e² = 961
f = 20 f² = 400
g = 27 g² = 729
h = 20 h² = 400
i = 31 i² = 961
j = 13 j² = 169
k = 23 k² = 529
l = 15 l² = 225
m = 6 m² = 36
Totals 248 5572
A a b c d e f g h i j k l m B
Arithmetical average = 248/13 = 19.1 microinches
Root mean square average = √(5572/13) = 20.7 microinches

14. Arithmetical average roughness . . .
and RMS average roughness can be calculated from profile charts of the surface. Calculations are simple but time consuming. Direct-reading stylus instruments are preferred for mass inspection of ferrous parts

the engineer. To be effective, such a standard must be easily interpreted by the machinist and leave no doubt as to the exact surface needed. It must also be of such a nature that the resultant surface can be inspected and evaluated with existing inspection equipment.

The ASA Standard for surface finish, ASA B46.1-1955, has been thoroughly covered at the beginning of this report. It is the common standard throughout the United States, is well defined and accurate. However, we feel that there are two disadvantages to the practical use of this system. **First, a good deal of confusion can result from misinterpretation of the numbers surrounding the symbol.** In some cases the roughness-width rating has been mistaken for the roughness-height rating, etc. Nor is there any place in the symbol for indicating the maximum permissible number of flaws; this number must be noted elsewhere on the engineering drawing.

The second disadvantage grows out of the first. Because of the complexity of the complete symbol, **the trend has been to omit all figures except the roughness-height rating—leaving the machinist to guess exactly what the engineer had in mind.** Should the surface be turned, ground, or honed? A good specification would leave no room for doubt.

Machining methods can be grouped according to the surface finishes they can produce (Fig. 13). Such correlations usually cover a roughness range of 0.5 to 1000 microinches. If we had a part that required a surface finish of three microinches, we would find that it falls into a microinch finish range that specifies lapping, polishing, or Superfinishing as the machining process. Other machining methods such as grinding, drilling, turning, etc, fall into other roughness classes.

A somewhat similar system, used by Carnegie-Illinois Steel Corp

(text continued on page 120)

INSTRUMENT EVALUATION CHART

INSTRUMENT	1P Use of Nonferrous Materials	2P Human Error Factor	3P Repeatability	4P Sensitivity	5P Accuracy	6S Capab. & Cap. of Method	7S Pract. of Method	8S Ease of Oper.	9S Maintenance	10S Ruggedness	11S Comb. w/other Methods	12S Portability	13S Cost
Askania Large Interfer	2	3	2	1	1	1	3	4	3	2	2	4	4
Sealol Planoscope—Type Z	2	4	2	3	3	2	3	1	2	2	2	2	2
H&W Surf Fin Microscope	2	2	2	1	2	4	2	3	3	2	3	1	1
H&W Scratch Microscope	2	2	3	3	3	3	1	1	2	2	2	1	1
T&H Talysurf, Model 3	3	1	2	2	2	1	1	3	3	3	3	2	2
B&L Surface Comparator	2	4	3	4	4	2	1	1	1	1	1	1	1
Coventry Interferometer	2	3	2	1	1	2	3	4	3	2	4	2	3
H&W Micro-Interferometer	1	2	2	1	1	3	3	3	2	1	2	3	3
Leitz-Forster Stylus Inst	2	1	2	2	2	3	3	3	3	3	2	2	2
Zeiss Intf Surface Tester	3	3	3	1	2	1	1	2	3	2	1	1	2
Proficorder	3	1	2	2	2	2	1	2	2	2	2	4	3
Zeiss Interference Micr	1	3	1	1	1	3	2	3	3	3	2	3	3
Leitz Roughness Tester	4	2	2	2	1	1	1	2	2	2	3	1	2
Profilometer	4	2	3	2	2	1	1	2	1	2	2	1	2
Unitron Microscope	1	3	2	2	3	3	2	3	3	3	2	3	2
Ballistics Microscope	2	4	4	3	4	3	2	2	2	2	1	1	2
Ultrasonics*	1	2	4	2	3	2	4	3	3	1	3	3	3
Photoelectric Cells	1	2	3	2	3	2	4	2	2	3	4	2	2
60° (Blade-Edge) Micr	2	2	2	3	2	3	2	2	2	3	1	2	2
45° Microscope	2	2	2	2	2	2	2	2	2	3	1	2	2
Air Gaging	2	2	3	4	3	3	3	1	2	1	2	4	2
Interference Comparator*	1	1	1	1	1	2	2	2	2	3	2	4	2
Mult-Beam Interference	2	2	1	1	1	2	2	3	3	3	1	3	3
Pulse Radar*	1	2	2	2	3	3	3	2	2	3	4	2	3
MTI Radar*	1	2	2	3	3	3	4	3	2	3	4	3	3
Simple Doppler Radar*	1	2	2	2	3	3	4	2	2	3	4	2	2
Range Doppler Radar*	1	2	2	3	3	4	4	2	2	3	3	3	2
FM Range-Measuring Radar*	1	2	2	3	3	4	4	2	2	3	3	3	2
Mult-Target FM Radar*	1	2	2	2	1	1	2	2	2	3	3	3	2
FM Doppler Radar*	1	4	2	2	4	3	4	4	3	4	3	4	3
AM Doppler Radar*	1	2	2	3	3	4	4	2	2	3	4	3	3
Superimposed Interference*	2	3	3	1	2	2	4	2	3	4	2	3	4
Sight Illum Comparison	3	4	4	3	4	3	3	1	1	1	1	1	2
Photocell Illum Compar	3	2	2	2	2	2	2	1	3	2	2	2	2
Zehender Replica Method	1	2	1	1	1	1	1	2	1	2	2	1	1
TiO_2-Coated Flats	1	3	2	3	3	3	2	1	1	3	2	2	1
Strang Flatness Tester	2	3	2	1	3	2	2	3	2	3	2	4	3
Sight Comparison	2	4	4	4	4	3	1	1	1	1	2	1	1
Bearing Pendulum	2	2	3	3	4	2	2	2	2	2	2	2	3
Surface Replica Analyzer	1	1	2	2	3	1	1	1	2	2	1	2	2
Hilger Interferoscope	1	3	2	3	3	2	1	1	1	2	2	4	3
KTA Intf Microscope	1	3	2	1	1	3	2	3	2	2	2	3	3
Faxfilm	1	4	3	4	4	1	1	1	1	1	1	1	1
Model 100 Talysurf	3	2	1	1	2	2	1	1	1	1	1	1	2

RATINGS: Excellent = 1; Good = 2; Fair = 3; Poor = 4

*Not in use

Instrumentation criteria . . .

All the instruments and techniques discussed in this report, plus several others, were measured against the criteria listed here. The letter "P" designates a primary point of consideration; the letter "S", a secondary point. Primary points are listed in order of importance; secondary points have no order of importance.

1P—Use on nonferrous materials—Can the instrument evaluate surface finishes on the selected nonferrous materials without impairing the surface? (The materials include cuprous and cupric alloys, aluminum, magnesium, and carbon structures.)

2P—Human error factor—Does the instrument minimize human error in its operation?

3P—Repeatability—Can the instrument give consistent readings on the same test piece?

4P—Sensitivity of instrument—Can the instrument measure small changes in surface structure?

5P—Accuracy—Can the instrument accurately define the surface condition according to the standard used?

6S—Capability and capacity of method—Can the instrument evaluate finishes on parts of various size, shape and material?

7S—Practicability of method—How sound is the principle of operation, as applied to measuring surface finish?

8S—Ease of operation—Can the instrument be easily read and operated?

9S—Maintenance—How expensive is upkeep on the instrument?

10S—Ruggedness—How well does the instrument resist external disturbances such as vibration, noise, shock, handling, etc?

11S—Combination with other methods—Can the instrument be combined or used in conjunction with other instruments?

12S—Portability—Can the instrument be transported from place to place without disturbing the relationship of its parts?

13S—Cost—How much does the instrument cost?

STANDARDS EVALUATION CHART

	1P Use on Nonferrous Materials	2P Repeat-ability	3P Capab. & Cap. of Method	4P Induced Error	5P Comb. with Inst.	6S Sim-plicity	7S Flexi-bility	8S Pract. of Method	9S Size	10S Human Error Factor	11S Mainte-nance	12S Cost
GE Std Specimen	4	4	3	3	2	1	4	2	3	3	1	1
Surfagage Std Spec.	4	4	3	3	3	1	4	2	3	3	1	1
T&H Std Specimen	4	1	2	1	2	1	4	2	2	2	2	3
Tol. Range vs Mach. Meth.	2	4	2	4	2	1	1	3	1	4	1	1
Arithmetic Average	2	2	1	2	1	2	2	2	2	1	1	1
RMS Average	2	2	2	3	3	3	2	2	2	3	1	1
Interference Photos	1	2	2	1	4	3	1	3	4	3	2	3
Profile Charts*	1	1	3	2	4	1	2	2	3	1	3	3
Int. Total Height Std	1	1	2	1	1	2	2	2	1	1	1	2
Carnegie Steel Std	2	1	1	2	1	2	3	1	2	2	1	1
Abbott & Firestone Curve	2	1	2	1	1	3	1	2	2	2	2	2
ASA Standard B46.1	3	2	2	2	3	4	2	2	1	4	1	1

RATINGS: Excellent = 1; Good = 2; Fair = 3; Poor = 4 *Not in use

Specification criteria . . .

Specifications for surface finish were measured against the criteria listed here. The letter "P" designates a primary point of consideration; the letter "S", a secondary point. Primary points are listed in order of importance; secondary points have no order of importance.

1P—Use on nonferrous materials—Can the standard be applied to specify surface finish on the selected nonferrous materials?

2P—Repeatability—Can the standard guarantee an equal quality of surface on all of the selected nonferrous materials?

3P—Capability and capacity of method—Can the standard encompass more materials and parts without basically changing it?

4P—Induced error—How accurate is the standard?

5P—Combination with instrumentation—Can the standard be applied and used with the various instruments available?

6S—Simplicity—Is the standard easy to use?

7S—Flexibility—Can parts of the standard be interchanged to satisfy a proper specification?

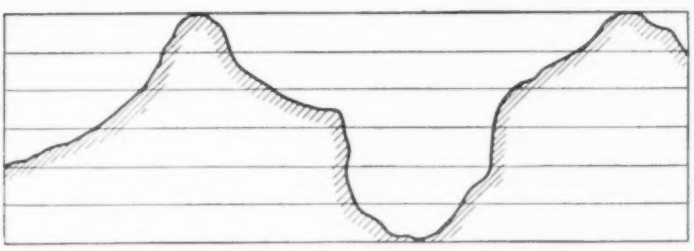
8S—Practicability of method—How sound is the principle upon which the standard is based?

9S—Size—Is the standard, along with its related instructions, physically bulky?

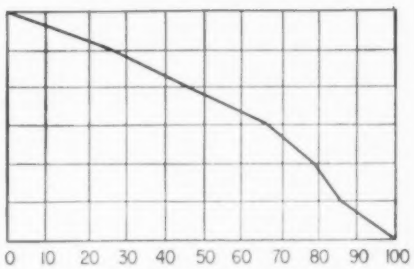
10S—Human error factor—Can the standard be misunderstood in application or in interpretation?

11S—Maintenance—How expensive is upkeep of the standard and related items?

12S—Cost—What is the cost involved in putting the standard into universal use?

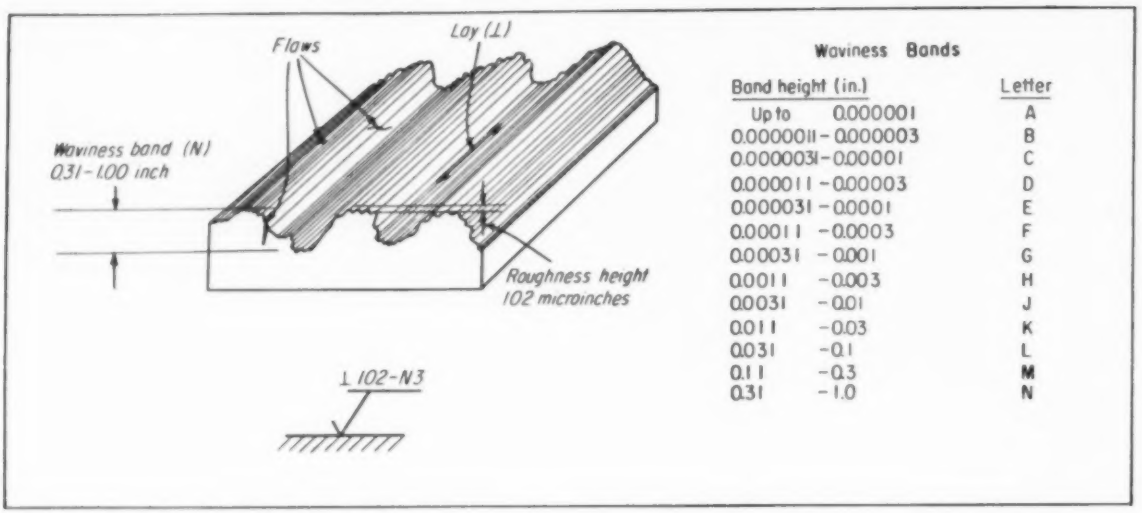


Surface profile



15. Abbott & Firestone curve . . .

describes a surface in terms of a percent of bearing area. A perfectly flat surface would represent a 100% bearing area, and would plot as a horizontal line on the graph. So far, this technique has been applied only to bearing surface analysis



Waviness Bands

Band height (in.)		Letter
Up to	0.000001	A
0.000001	- 0.000003	B
0.000003	- 0.00001	C
0.000011	- 0.00003	D
0.000031	- 0.0001	E
0.00011	- 0.0003	F
0.00031	- 0.001	G
0.0011	- 0.003	H
0.0031	- 0.01	J
0.011	- 0.03	K
0.031	- 0.1	L
0.11	- 0.3	M
0.31	- 1.0	N

16. Integrated total height standard . . .
is proposed in this report as a simpler and more meaningful standard than the current ASA standard. Fewer terms are involved, yet this standard provides place in the symbol for the number of flaws permitted

(United States Steel) for many years, assigned a letter symbol to each finish class. Letters ranged from A to K to designate finishes ranging from a four-microinch Superfinish to clean-up cuts with a roughness of 2000 microinches. An "A" finish, for instance, is classified as a superfinish; has a maximum average roughness of four microinches and a maximum peak-to-valley roughness of 15 microinches; must have a mirror-like surface without tool or file marks; and can be produced by grinding, Microhoning, lapping, burnishing or buffing.

Specifications such as these simplify the symbolism needed on a drawing, but set rather tight limitations on machining methods and permit no leeway on roughness. Nor is there any provision for waviness or lay indications.

Interference photographs, made with the camera attachment provided with most modern interference microscopes, could be cataloged and filed to provide a permanent record of every type of surface used in a particular shop. Each time a part is to be inspected, the inspector could simply check its interference pattern against the master photograph for that particular finish. The filing problem, when one considers the possible combinations of roughness, waviness, lay, and the number of flaws for the many possible surfaces, is an obvious drawback.

The integrated total height method of surface-finish specification, devised during this investigation, combines what we consider the best features of the standards already discussed. The symbols are shown in Fig. 16, and are essentially the same as those in the ASA standard. All the significant numbers are grouped along the horizontal extension line. From left to right on that line we have:

Lay (L)—the direction of the predominant surface pattern. The symbols used here are the same as in ASA B46.1-1955.

Total roughness height (102)—limiting height, from peak to valley, of the roughness pattern of the surface taken at a minimum of five different areas on the surface.

Waviness height (N) — limiting band for those variations of the surface that exceed the maximum roughness in total height and show a definite repetitive pitch.

Flaws per unit area (3)—number of flaws permitted in any one square inch of surface. Flaws are to include scratches, scars, pits, inclusions and checks.

This integrated total height specification is easily understood. If all four parts of the specification are used on the drawing, as they should be, the machinist will have a clear picture of the surface. This standard can be used with any surface finish measurement instrument on the market today. If an average evaluation is required, the total roughness height and waviness specifications can simply be changed to average surface roughness and waviness cutoff values.

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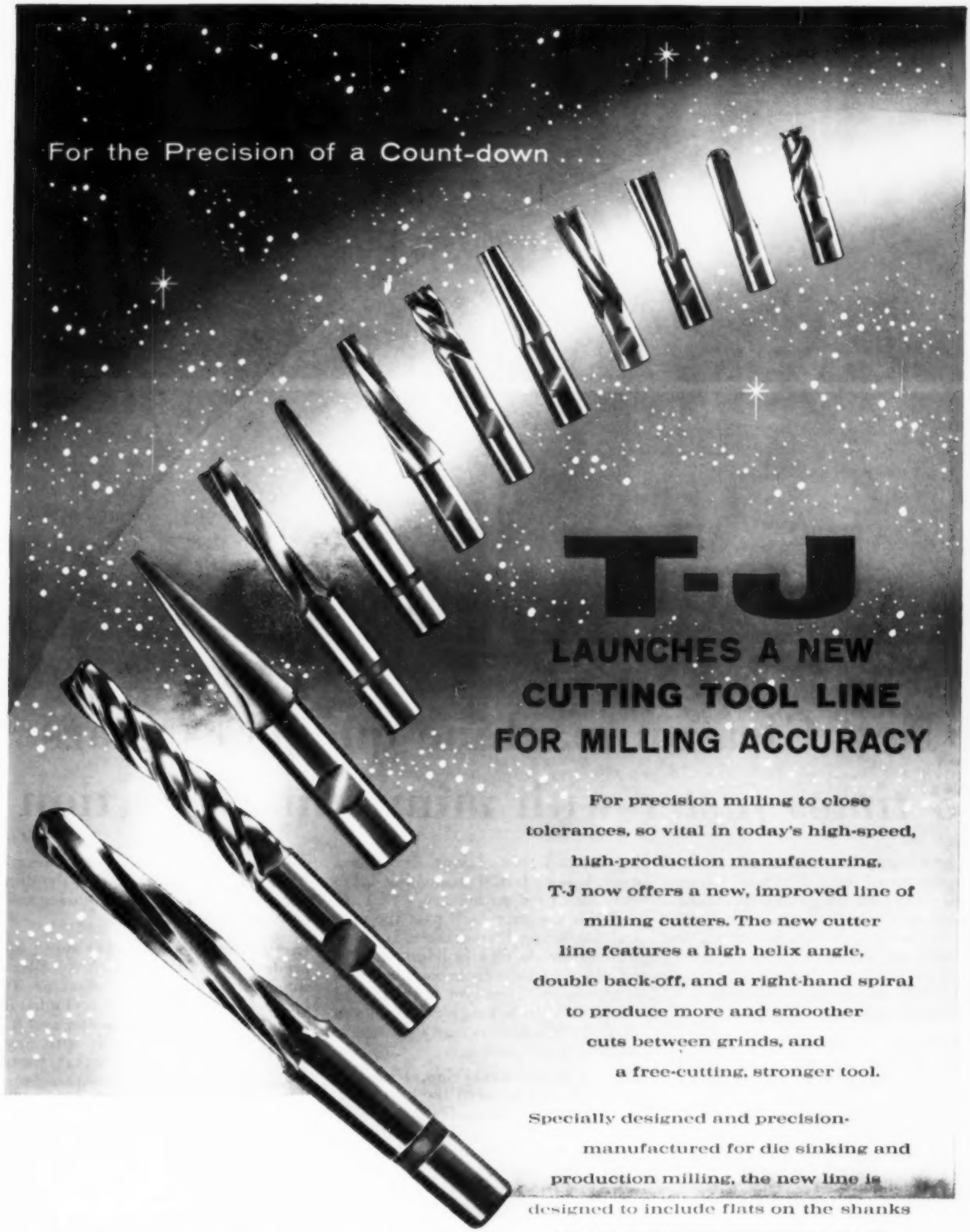

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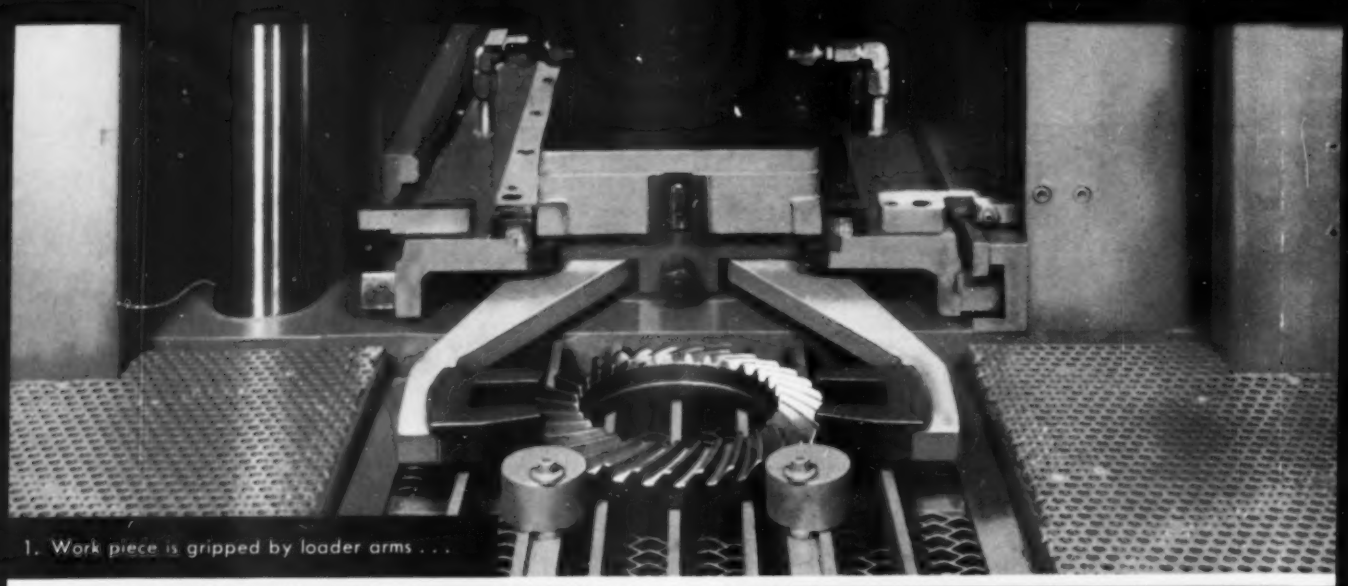
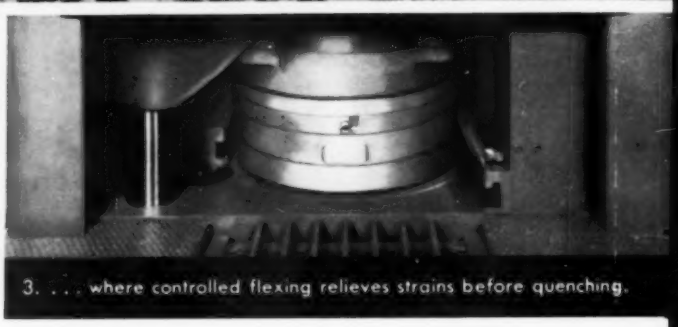


1. Work piece is gripped by loader arms . . .

2. . . . which move piece to quenching die . . .



3. . . . where controlled flexing relieves strains before quenching.

New Gleason machine quenches gears *3 times faster* with minimum distortion

The unique, fully automatic method incorporated into the new Gleason No. 117 Quenching Machine makes it possible to quench gears and other parts faster than ever before without significant distortion.

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When the part cools past the critical hardening temperature, it is released from the dies. Still immersed in oil, the part then cools completely as it travels on a conveyor to the unload chute. As soon as part is released from dies, the machine is ready to receive another work piece.

Flexing before quenching. Each hot part is flexed between the dies to relieve internal stresses. Rate and number of flexes are easily preset. Hydraulic pressure produces positive diaphragming action.

Pulsing. All pressure on the work is pulsed momentarily throughout the die-quench. This permits work to contract without strain. During the die-quench, oil flows uniformly over and around the part.

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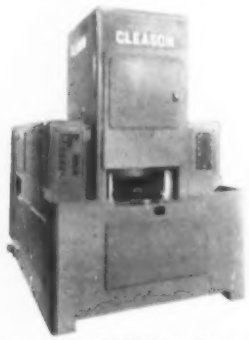
Gleason engineers are ready to help you step up productivity with this new machine. For complete details, write for bulletin.



Gleason No. 117 Quenching Machine

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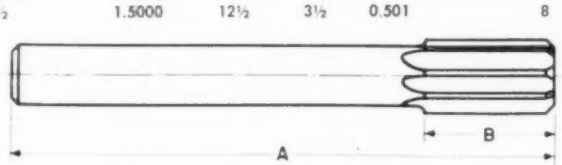
CIRCLE 232 READER SERVICE CARD

Standard Chucking Reamers

Straight-Shank, Straight-Flute, High-Speed Steel

Source: American Standard ASA B 5.14-1959, "Reamers," published by the American Society of Mechanical Engineers

Wire Gage	Dec. Equiv.	A	B	Size	Dec. Equiv.	A	B	Size or Letter	Dec. Equiv.	A	B
	Wire-Gage Sizes				**Fractional Sizes**				**Letter Sizes**		
60	0.0400	2½	½	3/64	0.0469	2½	½	A	0.2340	6	1½
59	0.0410	2½	½	1/16	0.0625	2½	½	B	0.2380	6	1½
58	0.0420	2½	½	5/64	0.0781	3	¾	C	0.2420	6	1½
57	0.0430	2½	½	3/32	0.0938	3	¾	D	0.2460	6	1½
56	0.0465	2½	½	7/64	0.1094	3½	⅞	E	0.2500	6	1½
55	0.0520	2½	½	⅛	0.1250	3½	⅞	F	0.2570	6	1½
54	0.0550	2½	½	9/64	0.1406	4	1	G	0.2610	6	1½
53	0.0595	2½	½	5/32	0.1562	4	1	H	0.2660	6	1½
52	0.0635	2½	½	11/64	0.1719	4½	1⅛	I	0.2720	6	1½
51	0.0670	3	¾	3/16	0.1875	4½	1⅛	J	0.2770	6	1½
50	0.0700	3	¾	13/64	0.2031	5	1¼	K	0.2810	6	1½
49	0.0730	3	¾	7/32	0.2188	5	1¼	L	0.2900	6	1½
48	0.0760	3	¾	15/64	0.2344	6	1½	M	0.2950	6	1½
47	0.0785	3	¾	¼	0.2500	6	1½	N	0.3020	6	1½
46	0.0810	3	¾	17/64	0.2656	6	1½	O	0.3160	6	1½
45	0.0820	3	¾	9/32	0.2812	6	1½	P	0.3230	6	1½
44	0.0860	3	¾	19/64	0.2969	6	1½	Q	0.3320	6	1½
43	0.0890	3	¾	5/16	0.3125	6	1½	R	0.3390	6	1½
42	0.0935	3	¾	21/64	0.3281	6	1½	S	0.3480	7	1¾
41	0.0960	3½	⅞	11/32	0.3438	6	1½	T	0.3580	7	1¾
40	0.0980	3½	⅞	23/64	0.3594	7	1¾	U	0.3680	7	1¾
39	0.0995	3½	⅞	⅜	0.3750	7	1¾	V	0.3770	7	1¾
38	0.1015	3½	⅞	25/64	0.3906	7	1¾	W	0.3860	7	1¾
37	0.1040	3½	⅞	13/32	0.4062	7	1¾	X	0.3970	7	1¾
36	0.1065	3½	⅞	27/64	0.4219	7	1¾	Y	0.4040	7	1¾
35	0.1100	3½	⅞	7/16	0.4375	7	1¾	Z	0.4130	7	1¾
34	0.1110	3½	⅞	29/64	0.4531	7	1¾				
33	0.1130	3½	⅞	15/32	0.4688	7	1¾				
32	0.1160	3½	⅞	31/64	0.4844	8	2				
31	0.1200	3½	⅞	½	0.5000	8	2				
30	0.1285	3½	⅞	17/32	0.5312	8	2				
29	0.1360	4	1	9/16	0.5625	8	2				
28	0.1405	4	1	19/32	0.5938	8	2				
27	0.1440	4	1	⅝	0.6250	9	2¼				
26	0.1470	4	1	21/32	0.6562	9	2¼				
25	0.1495	4	1	11/16	0.6875	9	2¼				
24	0.1520	4	1	23/32	0.7188	9	2¼				
23	0.1540	4	1	¾	0.7500	9½	2½				
22	0.1570	4	1	25/32	0.7812	9½	2½		**Decimal Sizes**		
21	0.1590	4½	1⅛	13/16	0.8125	9½	2½				
20	0.1610	4½	1⅛	27/32	0.8438	9½	2½	0.124		3½	⅞
19	0.1660	4½	1⅛	⅞	0.8750	10	2⅝	0.126		3½	⅞
18	0.1695	4½	1⅛	29/32	0.9062	10	2⅝	0.1865		4½	1⅛
17	0.1730	4½	1⅛	15/16	0.9375	10	2⅝	0.1885		4½	1⅛
16	0.1770	4½	1⅛	31/32	0.9688	10	2⅝	0.249		6	1½
15	0.1800	4½	1⅛	1	1.0000	10½	2¾	0.251		6	1½
14	0.1820	4½	1⅛	1 1/16	1.0625	10½	2¾	0.3115		6	1½
13	0.1850	4½	1⅛	1 ⅛	1.1250	11	2⅞	0.3135		6	1½
12	0.1890	4½	1⅛	1 3/16	1.1875	11	2⅞	0.374		7	1¾
11	0.1910	5	1¼	1 ¼	1.2500	11½	3	0.376		7	1¾
10	0.1935	5	1¼	1 5/16	1.3125	11½	3	0.4365		7	1¾
9	0.1960	5	1¼	1 ⅜	1.3750	12	3¼	0.4385		7	1¾
8	0.1990	5	1¼	1 7/16	1.4375	12	3¼	0.499		8	2
7	0.2010	5	1¼	1 ½	1.5000	12½	3½	0.501		8	2
6	0.2040	5	1¼								
5	0.2055	5	1¼								
4	0.2090	5	1¼								
3	0.2130	5	1¼								
2	0.2210	6	1½								
1	0.2280	6	1½								



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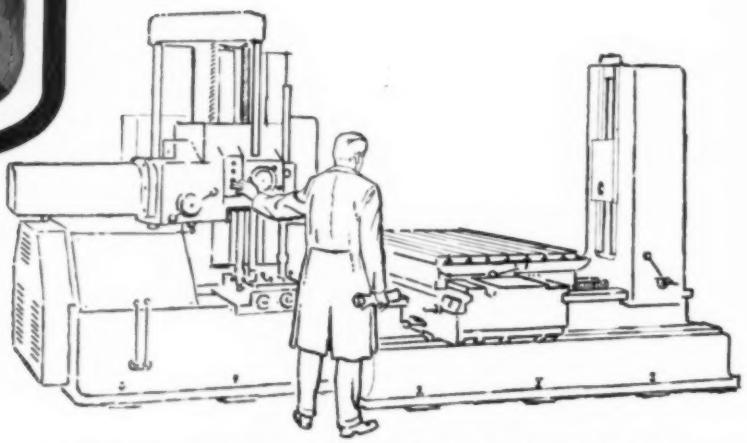

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Machining Titanium—I

Based on a survey of *current* machining practices in large and small shops throughout the country

By Bennet V Whiteson,
metallurgical engineer,
Titanium Metals Corp of America, New York

Drilling

Careful attention to chip formation in drilling titanium provides an accurate indication of drill condition. Uniform, smooth chips are produced by a sharp drill. When chips become shirred or feathered, the drill has dulled. When chips become discolored and irregular, the tool has failed. If the hole is to be tapped subsequently, generation of discolored chips may mean the work has been ruined.

Cobalt (T-4 or T-5) or molybdenum (M-10) high-speed steel drills are suitable for most drilling operations, while carbide drills are useful for deep-hole drilling on production runs.

Stub-type, screw-machine drills or short drills having the shortest possible length of flute should be used. Otherwise, use drill jigs.

Flutes should be large enough to prevent chips from clogging the drill, and drills should be long enough to provide unrestricted chip flow through the hole.

Point angle depends upon the hole diameter and operation involved (deep holes, sheet drilling, etc.). Blunt points (140°) are best suited to smaller-diameter holes (¼ in. and less), while sharp points (90°) are more suited to large-diameter holes where higher pressures are employed to feed the drill.

Double-point angle drills are recommended over single-point angle drills for larger size holes. The increased cutting surface on the double-point drill, which thins the chip and distributes the cutting load over a greater area of the cutting lip, provides approximately 25% greater drill life over single-point angle drills. Grinding a spiral point on a drill produces a tool with marked superiority, for most titanium drilling operations, over the conventional chisel edge.

For deep, small-diameter holes, sulfo-chlorinated oils are the best coolant.

Tapping

Tapping is probably the most critical machining operation on titanium. Use rigid equipment with sharp, clean taps of proper design. Do not attempt tapping if the drilled hole indicates any sign of burning or roughness.

Spiral-point, interrupted-flute taps employed at slow speeds yield the best results. Because of high

Drilling Data

Type of Operation	Tool Material
General drilling	T-4 or T-5 HSS
Deep holes, low production	T-5 HSS
Deep holes, high production	C-1 or C-2 carbide
Sheet, power drilling	T-4, T-5, or M-10, HSS
Sheet, hand drilling	M-10, T-4 or T-5 HSS

Tool Geometry

Operation	Tool Angle	HSS	Carbide
General and Deep Hole Drilling	Point angle,°		
	Less than ¼ dia.	140	Single lip
	¼ to ½ dia.	90 or double angle	Gun drill
	Helix angle,°	28-35	—
	Relief angle,°	9-10	6-8
	Cutting angle,°	0	—
	Body clearance	Yes	—
Sheet, Power Drilling	Point angle,°		
	Less than ¼ dia.	135	
	¼ to ½ dia.	118	
	Helix angle,°	15	Not Recommended
	Relief angle,°	12-15	
	Cutting angle,°	0	
	Body clearance	Yes	
Sheet, Hand Drilling	Point angle,°		
	Less than ¼ dia.	150	
	¼ to ½ dia.[a]	135	
	Helix angle,°	15	Not Recommended
	Relief angle,°	12-15	
	Cutting angle,°	0	
	Body clearance	No	

(a) Freehand drilling not recommended over 5/16 dia.

Machine Setting	Titanium Grades		
	Commercially Pure	All Alloy Grades	
		Annealed	Heat-Treated
General and Deep-Hole Drilling With High-Speed Steel			
Speed, sfpm	40-60	20-50	5-40
Feed, ipr			
less than ⅛ dia.	0.0015	0.0015	0.0015
⅛ to ¼ dia.	0.002-0.005	0.002-0.005	0.002-0.005
¼ to ½ dia.	0.005-0.009	0.005-0.009	0.005-0.009
Drilling Deep Holes With Carbide Drills			
Speed, sfpm	200	100-170	75-145
Feed, ipr	0.0005	0.0005	0.0005
Sheet Drilling With High-Speed Steel			
Speed, sfpm	15-40	20-30	10-25
Feed, ipr	0.002-0.005(a)	0.002-0.005(a)	0.002-0.005(a)

(a) Hand drilling titanium requires approximately twice the axial force for drilling aluminum

Photo courtesy of National Screw & Mfg. Co.

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Machining Titanium—II

galling and seizing characteristics of titanium, small amounts of work material may smear onto the tap crests and lands. Initially, small pieces of titanium are carried away, leaving oversize threads and a rough surface. If cutting is continued, torque values increase rapidly, and the tap either seizes in the hole or breaks.

Standard 75% threads are difficult to obtain at normal production cutting speeds. Accordingly, 65% threads are recommended whenever possible, because they yield a 300% increase in tap life.

The most successful taps have interrupted threads, with the alternate teeth removed. Eccentric grinding of the thread crests so that only the first third of the thread contacts the titanium has been successful. Some improvement can be obtained through grinding a large chamfer in the trailing edge of the tap, to reduce rubbing between tap and work.

For through-holes, a chip-driving, spiral-point tap should be employed.

Paste-type cutting compounds give excellent results, and sulfo-chlorinated oils are also acceptable. If oils are used, they should be frequently filtered.

Reaming

There is some tendency for reamer lands to gall and seize, but proper tool design and operating conditions eliminate this problem. Helical-fluted reamers provide a wide, thin chip, and generally have longer tool life than straight-flute reamers. Margins greater than 0.010-in. are likely to cause galling and scoring, while thinner margins may cause chatter.

Feeds should be increased in proportion to the diameter of the hole.

Broaching

Successful broaching depends primarily on slow speeds and heavy equipment.

A rake angle of 15° to 22°, and clearance angles of 5° to 8° have been employed successfully in broaching titanium. The broach should have a full gullet ahead of the cutting edge, so that the chip can curl easily and not clog the cutting edges. These should be honed in the direction of chip flow.

Cutting speed is approximately 3 fpm and chip load is 0.002 to 0.005 in. per tooth.

Sulfurized-chlorinated oil is the best cutting fluid.

Tapping Data

Tool Material: T-1 high-speed steel

Tool Angles:

Spiral point angle, °	10-17
Spiral angle, °	110
Relief angle, °	2-4
Cutting rake, °	6-10
Heel rake, °	—3
Chamfer	5 threads
No. of flutes	
¼-20 and less	2 flutes
Over ¼-20	3 flutes

Machine Setting	Titanium Grades		
	Commercially Pure	All Alloy Grades	
		Annealed	Heat-Treated
Speed, sfpm	40-50	10-30	5-20

Lubricants:

(1) Lithopone paste (30% SAE 20 oil + 70% lithopone)
(2) Sulfurized-chlorinated oil

Reaming Data

Type of Cutting	Tool Material
Normal operations	T-1 or T-5 HSS
High speed production	C-3 or C-4 carbides

Tool Geometry

Tool Angle

	Tool Material	
	Carbide	HSS
Clearance angle, °	10-15	10-15
Relief angle, °	5-10	5-10
Margin or land	0.010-0.015"	0.010-0.015"

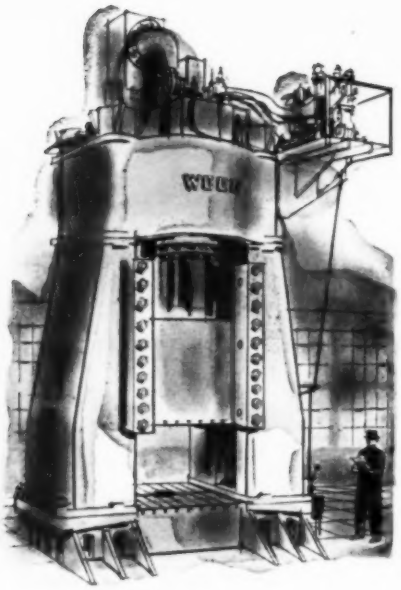
Machine Setting

	Tool Material	
	Carbide	HSS
Speed, sfpm	100-200	20-30
Feed, ipr	0.005-0.008	0.005-0.008
Depth of cut, in.	Up to 0.030(a)	
Coolant	Sulfurized-chlorinated oils	

(a) With power feed equipment

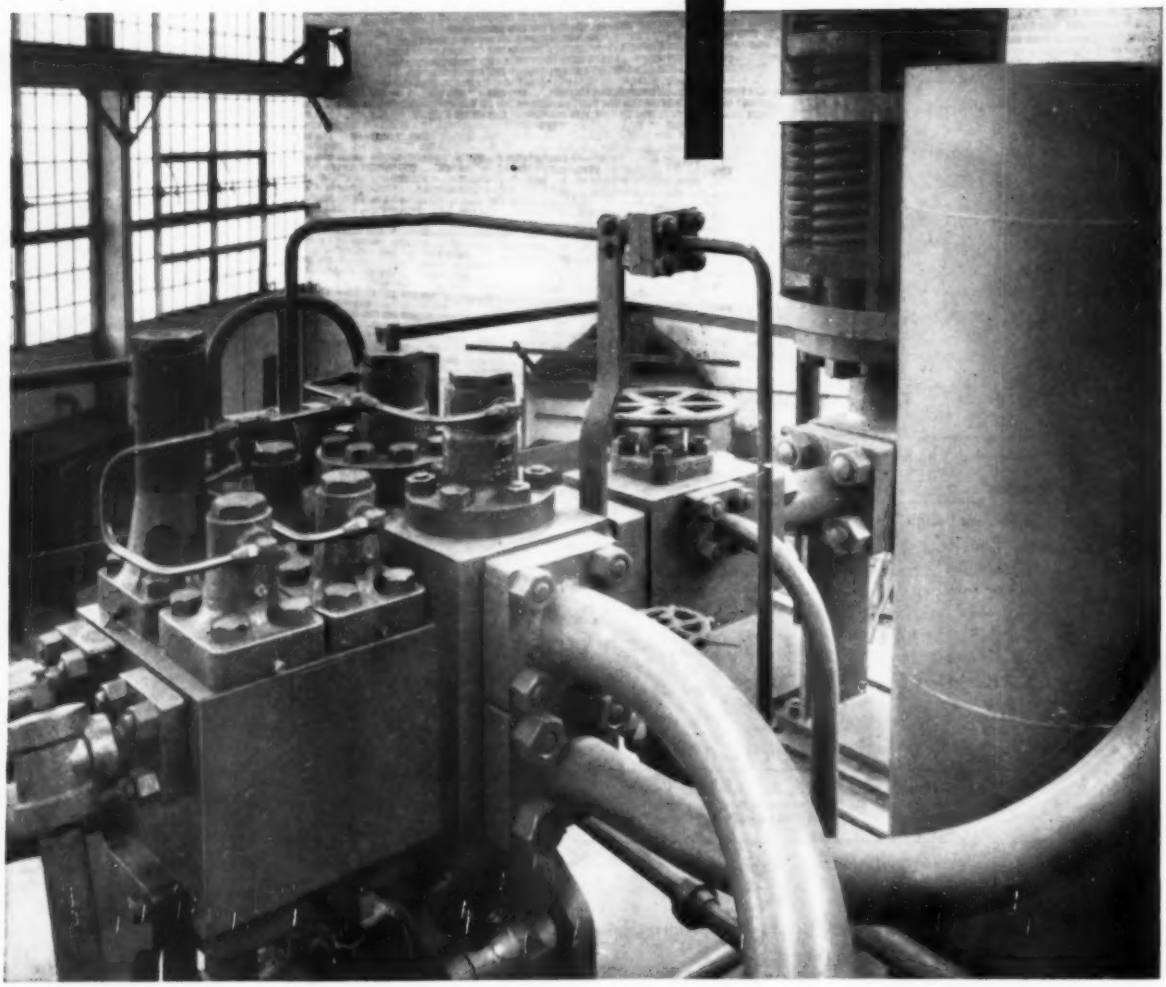
Treat 'em rough,
These Wood Valves can take it.

Presses take a beating? No need to worry about the effect on your hydraulic system if Wood Valves are at work. They're built to handle the toughest jobs. For example, this 3"x1½" special main control valve is installed on a 1500 ton forging press. Operating conditions demand extremes in acceleration and deceleration, yet the valve assures shock-free, efficient service due to its inverse flow design. Control of the ram is precise, accurate . . . with shockless decompression. You can also see a fully balanced throttle valve and a 3"x7" shock alleviator, further examples of Wood's complete line of quality high-pressure valves. Write today for complete information.

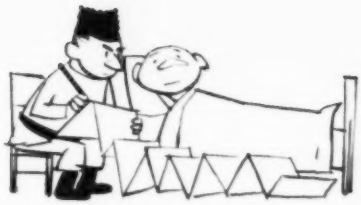


R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA



Talking Shop...



Red Tape

IZVESTIA COMPLAINS that Russian bookkeeping is having a disastrous effect on industrial production. There are far too many forms to fill out and they are far too complex. "The sick leave certificate holds out real calamities for bookkeepers because the calculations are so complex. No less laborious is the operation of deducting taxes from employees going on leave."

Centering its ire on the Central Statistical Administration, Izvestia charges that "instead of abolishing superfluous accounting forms, these organizations seek to retain them."

Sounds just like America.

Cafeteria Talk

A HAMBURGER by another name is more expensive.

$5000 Top

FOR OUR PERIODIC progress report on suggestion plans, we select the news that General Motors has raised the top amount available to $5000. The origina' top award was $750, raised to $2500 in 1951. Of half a million suggestions adopted, 1500 have been for the top amount. In the first three months of this year, more than a million dollars was paid out in suggestion awards.

"Space" Car

STARTING WITH satellite research in electro-chemical propulsion, De Soto has built a scale model of a car powered by a chemical generator. The energy is fed to separate electric motors for each wheel.

Outside Ideas

A GOOD OUTLET for an idea that can be used within the company is provided by suggestion plans. But what about the really good idea that can only be used somewhere else? Based on the assumption that "it takes more to sell a new idea than to have it," North American Aviation has established a subsidiary to investigate and sell original ideas. Navan Products is now handling more than 200 license agreements and is now testing a dozen or more new products. Navan is one organization that welcomes outside ideas for almost any field, whether they originate with companies or individuals. Navan Products is at International Airport, Los Angeles 45.

Tin Dies

ALUMINUM STAMPINGS are being made in Poland with a steel punch and a tin die. The die is made from 0.234-in. rolled tin (92.46% zinc, 3.5% copper, 4% aluminum, and 0.04% manganese) supported on a rubber cushion. The steel punch is also surrounded by a rubber cushion. Developed at the Polish Aviation Institute, according to *Glos Pracy*, a Warsaw publication, the tin die lasts for 5000 punches from 2-mm aluminum alloy and for 2000 punches from 1.2-mm steel strip.

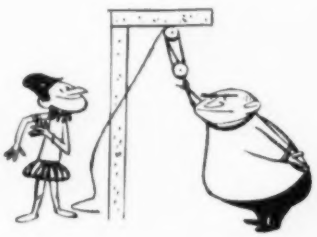
Turn Backward

THE "TWIN EFFECT" of Einstein's theory has come in for new talk since the NASA has put Hughes Aircraft to work building an atomic clock (24 billion ticks per second) to put the theory to the test. The theory says that as you travel faster everything moves slower and at the speed of light time stands still. There are a number of limericks on the theory and one of the cleaner ones goes:

There was a young lady named Bright,
Who could travel much faster than light.
She rode out to the stars,
Paid a visit to Mars,
And came home the previous night.

MEMOS

by BESS RITTER



If Queen Elizabeth hadn't condemned the Earl of Essex to death for the crime of treason, it is possible that today's hoisting apparatus, which we call a "derrick" would have an entirely different name. It originally belonged to a man named Derrick, who happened to be the executioner appointed for the job.

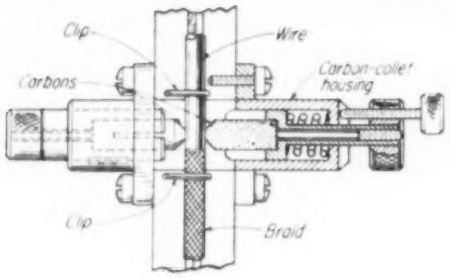
Ordinarily, he would have hung Essex on the gallows, as was the current custom, but it was decided that the Earl's head be chopped off instead, because his station in life was far too high for his body to be permitted to dance lifelessly in mid air. Consequently, the job was done with an axe, much to the subsequent suffering of both the Earl and Mr. Derrick.

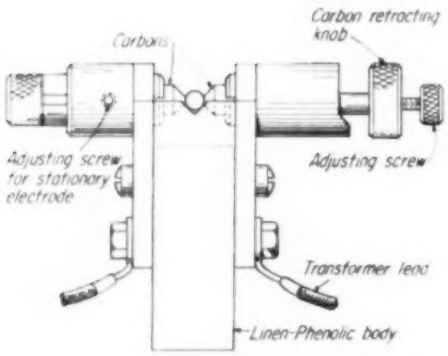
The Earl suffered because it took three painfully bloody blows to completely sever the body from the head. Derrick suffered because the victim was a highly popular character, and the anger of the onlookers was so great that Derrick was saved from a painful death himself only because the soldiers of the Queen promptly interceded.

This executioner lived on to perform many, many more executions at the famous Tyburn prison, but his unpopularity never waned. Instead, it grew so strong that his instrument of death actually came to be known as a "derrick" as well, and perhaps if he had employed the axe for all his work, we'd be calling this tool by the name of "derrick" now. However, since he usually hanged clients, "derrick" and "gallows" became synonymous terms, and later on when a hoisting apparatus was invented which resembled the "derrick" this machinery also became known by this name.

Practical Ideas . . .

Work-holding Fixture Simplifies Silver Soldering





Our engineering order was to silver solder gold-plated flexible wire-braid between two sections of No. 24 gage copper wire. The diameter of the braid was approximately 0.020 in., or identical to the wire diameter.

The specifications further stated that annealing in the joint area should be kept within 0.060 in. at the ends of the braid sections. Joints had to be sound, with all strands of the braid secure, and could not exceed the wire diameter. Oxidation was to be kept at a minimum, and no manual finishing, other than hot water or a degreasing bath to remove flux, was allowed.

Similar problems are frequently encountered in the field of research and development. They are not unusual, but their satisfactory solution may be. In our particular case, a solution had to be found to satisfactorily produce these assemblies in order to make a vital missile component function reliably.

My previous experience in silver soldering miniature assemblies helped me in selecting the tools, equipment, and method required. After having decided on employing the incandescent-carbon method, I fashioned the fixture shown in the sketch. A low voltage-high amperage transformer and carbon electrodes made it possible to melt the solder alloy in seconds. The carbon electrodes were salvaged from flashlight batteries and freed from electrolyte by heating them with a torch.

The soldering alloy, Easy-Flo No. 45 filed to produce granules, provided the necessary bonding strength at a melting point between 1125-1145° F. Wires and braid were prepared so they would butt squarely against each other and then degreased to eliminate contamination that would affect soldering. The flux was mixed to a consistency of thin paste, and a quantity of the solder-alloy granules was placed on a clean piece of paper.

The soldering operation is carried out in the following order: A copper wire is positioned in the fixture as shown in sketch, the electrodes firmly against both sides of the wire to prevent arching. Flux is sparingly applied to the end of the braid and while still wet, it is dipped into the solder granules to pick up a small amount. There is more danger in getting too much than not enough.

The prepared end of the braid is then placed in the fixture, butting against the wire, and secured with a spring clip. During the heating cycle when current is applied by a foot switch, the fixture is shifted to a vertical position with the braid uppermost. In this way, the solder is prevented from creeping into the braid beyond the allowed limit.

Joint completed, the clips holding the wire and braid are removed and the knob on the spring-loaded carbon collet is pulled back and given a quarter turn clockwise. In loading, the knob is rotated counter clockwise to allow the electrode contact with the wire, pressure on which is controlled by an adjusting screw. Clean electrodes are necessary for positive contact against both sides of the wire.

Samuel J Yasho, Los Angeles, Calif

How to Use A Three-Jaw Chuck

To discuss the use of a scroll-type universal chuck, or more specifically, the method of tightening it, may seem like a hypothetical topic. But, there is a right and a wrong way of chucking a piece to achieve what such a chuck is designed to accomplish. It is also important to follow the right procedure to protect the accuracy of the chuck.

Each of the three jaw-operating spindles, located on the periphery of the chuck, has its own distinct effect on the chuck's accuracy. The reason for this apparent independent action is that there is, necessarily, some clearance between the mating surfaces of the scroll and the body of the chuck where it is mounted.

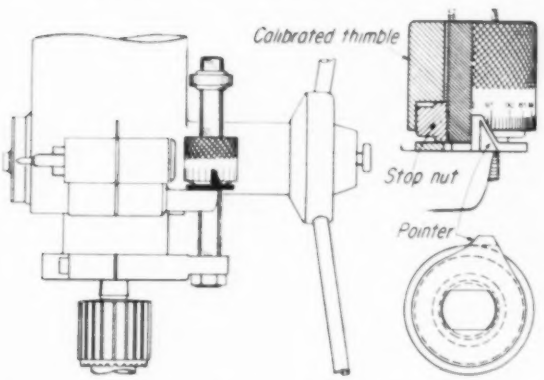
When a wrench is applied to one one these spindles, the scroll is forced off center the amount of that clearance. Should the wrench be used on another of the two remaining spindles, the scroll will move to a different position according to the torque applied. It is in this process that the proper use of the chuck lies.

Because each chuck has its own characteristics, due to manufacture, wear, and reaction to load, the simplest way to learn how to handle a chuck is by experimentation. The best way you can do this is to place a round bar (preferably ground) in the chuck as a reference piece. With an indicator contacting the bar, lightly tighten the jaws using the wrench in different positions as you would when tightening an independent chuck.

While observing the indicator during the tightening at the three positions, you'll quickly discover the sequence that results in maximum concentricity. Mark this sequence on the chuck so that it can be duplicated in future setups.

Kenneth Heyer, Inglewood, Calif

Drillpress Efficiency Increased with Micrometer Depth Stop



As we have no light milling machines in our school shop, we sometimes have to resort to the use of drillpresses when milling plastic, brass, aluminum and other soft material. This has worked out well with the aid of a small rotary table equipped with cross and longitudinal hand feeds, as workholder. However, we had no convenient and accurate control of the depth of cut.

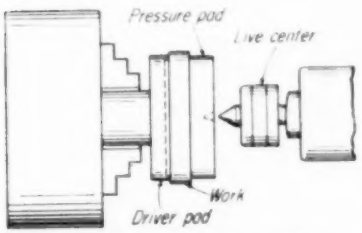
After having canvassed the machine-tool market for a commercially-made product without success, I decided to design and make my own. The result shown in the sketch, is designed to fit a 17-in. Delta drillpress which has a stop-nut post with 10-pitch thread. This pitch made it simple to calibrate the attachment in increments of 0.001 in. or a total of 0.100 in. per revolution.

The attachment is easy to make. It incorporates one of the stop nuts over which a knurled and calibrated thimble is pressed. The diameter of the counterbore receiving the nut is small enough to allow the knurl on the nut to score it for positive anchorage. A setscrew is also provided for locking the two members together. Note that the counterbore covers only the knurled section and one of the two relieved ends of the nut which, incidentally, bottoms in the counterbore. The relief on the other end protrudes and is the actual point of contact.

Reaming or boring the thimble to but a few thousands clearance over the major diameter of the post, eliminates side lash inherent in the fast-running threads used on stop posts. Calibrations are produced in a milling machine with the aid of a dividing head set for 100 divisions.

The indexing finger is made with a close-sliding fit on the flats and OD of the post. It is not attached to the micrometer thimble or nut in any way, but is allowed to rest on the quill-housing stop. The locknut, or second nut, is not discarded but left at the top of the post where the operator may use it if needed. One occasion that may call for a locknut would be if a lot of milling or drilling has to be done at the same depth.

Fred P Faltersack, asst prof, mechanical engineering, University of Santa Clara, Santa Clara, Calif



Friction Holds Disk in Lathe

The order called for a small quantity of floating gear blanks which were to be machined to close diametrical and thickness tolerances. Finished, they would be blanks used in the production of floating gears with no through holes permitted. This eliminated what would have been a simple solution of mounting the blanks on a mandrel for turning their diameters. However, after having decided on the friction drive shown, which requires a minimum of tooling, the job was done quickly and efficiently.

The pieces of material for the blanks were cut oversize from round stock and placed in the surface grinder. Here they were ground to the required thickness with equal amounts ground off both sides to prevent distortion or warping.

Depending on the extent of usage, the driver can be made from materials ranging from mild steel to aluminum. The stock selected was chucked in the lathe and turned down to a diameter slightly under that of the finished blank. It was then faced and given a shallow undercut. The pressure pad was made from steel, ground on both sides, and turned to the same diameter as the driver after having been provided with a center hole.

Work is mounted by centering a blank, followed by the pressure pad, against the driver face. A live center is next seated in the pressure-pad's center hole to provide the pressure and steadyment for turning the blank.

Norman Fried, Los Angeles, Calif

Here's a Tool Box Space Saver

A plastic replacement face for a soft-faced hammer, generally available at hardware and tool stores, makes it easy to convert an ordinary hammer into a soft face one.

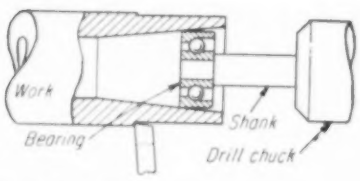
The plastic face is chucked in the lathe, and a blind hole with an inside lip is bored into it. The aim should be for a snug fit over the ball peen end of the hammer because the best fit will give the best action. The lip is designed to snap fit over the back of the ball.

When a soft face is required, the plastic piece is quickly snapped in place. And should the ball peen be needed, the soft end is just as easily pulled off.

This combination soft face and ball peen hammer is a simple way to save space in your tool box.

Norman Fried, Los Angeles, Calif

Practical Ideas...



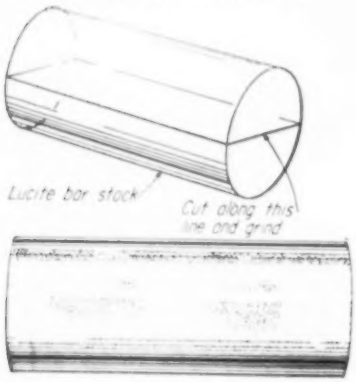
Ball Bearing As Live Center

A job I would frequently get calls for was turning the OD of tubes having a tapered bore at one end. Therefore, as the OD had to be machined concentrically with the tapers, a tailstock support was needed. And because a live pipe center wasn't available, I fabricated the substitute shown.

It consists of a radial thrust ball bearing which is fitted with a shank and gripped in the tailstock drill chuck. When the chuck is accurate and the bearing is concentric with the shank, machining can be held to close tolerances.

The fact that the tapers vary from piece to piece does not hamper the usefulness of this tool. In use it is merely entered into the taper while the other end of the tube is loosely held in the lathe chuck. After the bearing has found its seat, the lathe chuck is tightened as required.

John G Bailey, Pittsford, NY



Lens and Oil Reveal Surface Quality

Did you know you could spot check the quality of scraped surfaces with a simply made lucite lens and some oil? Here's an inspection method that's both fast and accurate.

Select a piece of lucite barstock of about 2 in. diameter and 4 in. long. Cut it in two along the axis, forming the lucite lens, then grind the contact surface flat as shown in the figure. This surface must be flat, for it will be the standard that determines the surface quality of the scraped area. It isn't necessary to machine any other surface of the lens.

Blacken some oil by adding some graphite or molybdenum sulfide, then clean the surface you want to examine and deposit a few drops of this oil on it. Place the lens over the oil, press down firmly, and move back and forth several times. A magnified picture of the surface will appear through the lucite lens, with high spots showing bright, low spots dark.

John Obrebski, Sidney, Ohio

Classification Simplified With Mask on Dial Face

After having produced a large number of special screws, it also became our job to categorize them in four classes of fit during inspection. For this job we used a dial type bench comparator equipped with roll-thread contacts. Reading the dial for the many random sizes (0.007 in. from high to low limits was divided into the four categories) become a painstaking, confusing, and often unreliable process.

This was greatly simplified by placing a mask, carefully ruled with india ink on gummed paper, on the dial face. Markings connect the significant divisions on the dial to the pitch diameters involved. An auxiliary chart, placed directly below the dial, classifies the dial measurements into four groups.

The mask is made to only partially cover the dial face. Its radius must be small enough to show the dial numbers and graduations, as well as the pointer.

H J Gerber, Stillwater, Okla

David H McArel
Havertown, Pa

WON

$25 **In addition to regular payment for his idea:**

QUICK-ACTING EXPANSION ARBOR

in the June 1, 1959 issue

An extra $25 will be paid for the best Practical Idea in each issue of *American Machinist*. Selection of the winner is made by a group of our readers.

PAYMENT—$25 in addition to regular rates for the items published to be paid as soon as reader votes are received—usually three to four weeks after the date of issue. The winner will also be announced in these pages as soon thereafter as practicable.

JUDGES—A group of 200 *American Machinist* readers in asked to select preferred articles in each issue. The group is a true cross section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in a tie, $25 will be paid to each co-winner. Decision of the readers will be final in each case.

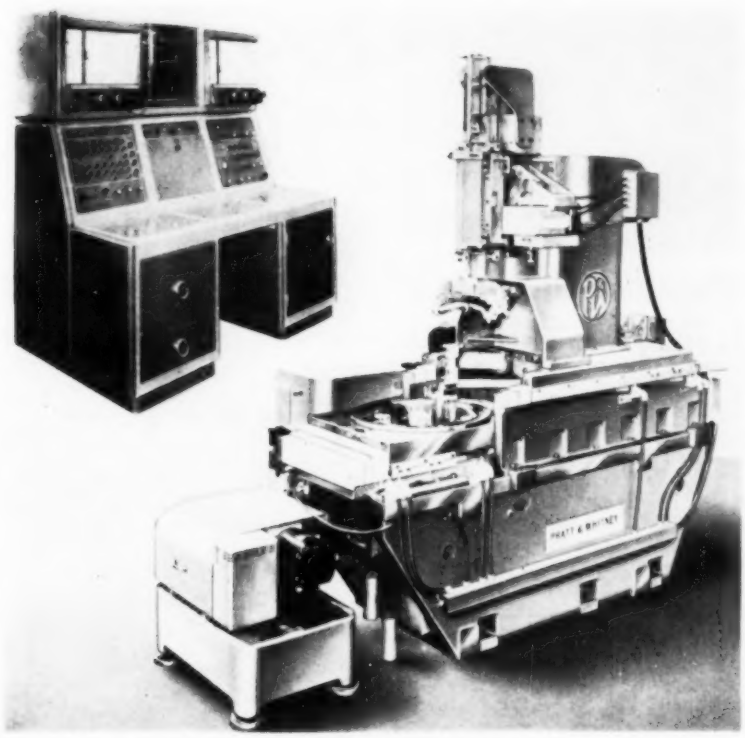
REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer, or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER — Anyone may enter except employees of the McGraw-Hill Publishing Co, Inc, and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER — Send all entries to "Practical Ideas Editor," American Machinist, 330 West 42nd St, New York 36, N.Y.

New Shop Equipment

Materials and Parts



Numerically Controlled Measuring Machine Checks Complicated Shapes Automatically

Numerically controlled Pratt & Whitney gaging machine is designed to check complicated shapes automatically and provide gage data processing. Without using templets or special gage tooling, the machine can check such shapes as missile parts at any desired number of coordinate points on inner or outer surfaces.

Known as the Data-Limit six-coordinate measuring machine, the instrument has two gaging arms. Each arm moves in X, Z and Theta coordinates — horizontal and vertical movement plus rotary motion around the X and Z coordinates—to insure that measurements are always made normal to the surface of the workpiece.

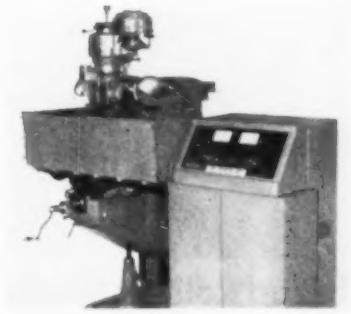
Input data carried on perforated tape is used to move the gaging arm and head to a reference point on the workpiece, then position the gage head at a desired series of points in space. At each point the gage head measures the deviation of the surface from its nominal location.

Digital readout makes it possible to store, record, or mathematically process the gage data in a variety of ways. It can be used to control the sorting or classifying of products. Readings can be remembered, added, subtracted, multiplied, or divided and used to compute taper, wall thickness, average section, or other dimensional relationships.

Over all gaging accuracy is 0.000150 in. with a repeatability of 0.000050 in. Ways, which are hardened, ground, and lapped to a 2-3 rms microinch finish, ride on rolls ground to an accuracy of 0.000010 in.

Pratt & Whitney Co, Inc, West Hartford 1, Conn

MORE DATA? Circle 51, inside back cover



Improved Equipment Offered for Electrical Discharge Machining

Features of line of equipment include new circuits involving the power supply as well as the power feeds essential to this type of machining. These circuits make possible greater cutting current at the work from a reduced number of tubes. Design also includes a more informative control panel, and a unit-type construction that simplifies maintenance.

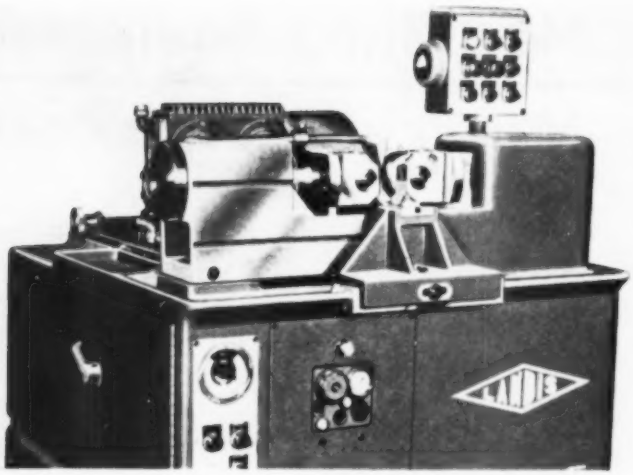
Initial production is being concentrated on units of 20, 40, 60, and 100-amp ratings; much larger units will be introduced later in the year.

Matson Co, 8771 Grinnell, Detroit 13, Mich

MORE DATA? Circle 52, inside back cover

Small Size X-ray Unit Uses Pulsed Beam to Gage Thickness

New Daystrom short-pulse X-ray thickness gages are offered in smaller size models (left). Designed for thickness measurements ranging from 0.00025-in. foils to 1½-in. plates, the gage uses a sharply pulsed pencil



Thread Rolling Machine Handles Diameters To 2 in. With Infeed or ¾ in. With Thrufeed

Small range thread rolling machine introduced by Landis handles diameters up to 2 in. with the infeed method of rolling and up to ¾ in. with the thrufeed method. Designated the Lan-Nu-Rol, the unit is operated pneumatically with hydraulic operation available as an option.

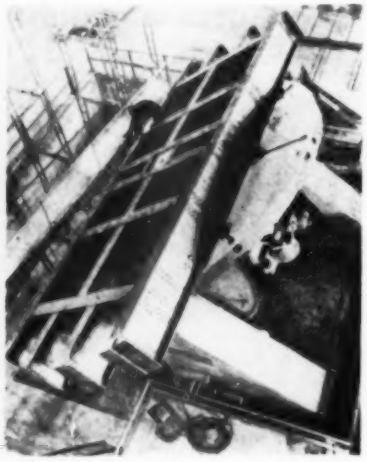
Spindle speeds are infinitely adjustable from 166 to 500 rpm through a pully arrangement which requires no gear changing. A simple, efficient worm gear transmission, designed with only two gear contacts, has a high overload capacity.

Two cylindrical thread roll dies are mounted on inclinable roll holders adjustable to 10° left or right. The 10° inclination handles all AN, UN and Acme thread forms within the machine's capacity.

With infeed rolling, the right movable die is advanced and withdrawn by a pneumatically operated toggle system capable of 60 cpm. Extremely high rolling pressures are obtained with a minimum of deflection and stress and a maximum of thermal stability. Manual, semi-automatic or automatic cycling is available with a full complement of automatic feeding equipment for thrufeed rolling operations.

Landis Machine Co, Church and 5th Sts, Waynesboro, Penna

MORE DATA? Circle 54, inside back cover



WORLD'S LARGEST WELDING POSITIONER, according to the manufacturer, is this 200,000-lb capacity unit installed in Bucyrus-Erie's Milwaukee plant to position large frames for power shovels. It measures almost 14 ft high with the 16 sq ft table horizontal and uses two 25-hp motors to drive the tilt—*Worthington Corp, Harrison, NJ*

MORE DATA? Circle 55, inside back cover

X-ray beam to measure a wide variety of materials and metals at speeds up to 6000 rpm.

According to company engineers, the pulsed X-ray source greatly reduces the already low radiation level of the gage which requires only a minimum of shielding and makes possible a source unit only ⅛ the size of previous units.

Capable of measuring thicknesses to tolerances of ±0.000010 in., the XactRay gage consists of an X-ray generator, and X-ray incident unit to detect the amount of transmitted energy, and an indicator console containing electronic elements to convert and compute the variation of transmitted energy into terms of thickness variations.

Industrial Gauges Dept, Daystrom, Inc, 461 Frelinghuysen Ave, Newark 12, NJ

MORE DATA? Circle 53, inside back cover

Honing Machine Designed for High Production of Small Parts

New version of the Barnes Drill Model 10 honing machine is designed for manual or automatic honing of bores from ¼ to 1½ in. dia. Control panel has been raised to a more readable position, front of cabinet is fully enclosed, and head has been restyled.

Rotation and reciprocation are powered by mechanical connections, and pneumatic controls are used for hone feed, including automatic expansion and collapse, and for automatic compensation for stone wear. The transmission assembly and spindle are suspended between double posts for maximum rigidity and accuracy. No hydraulic circuitry is required.

The machine has 0 to 2½ in. stroke with a 6 in. withdraw stroke and a maximum swing of 10 in. Rotation and reciprocation are powered by a ¾-hp motor. Model 10 is avail-

able with an air-operated six-station rotary indexing fixture and can be furnished with a variety of automatic equipment.

Model illustrated has tooling designed to hone bearing rod ends and inner races with ID from 0.4995 to 1.005 in. and stock removal from 0.006 to 0.008 in. At 80% efficiency, production is 131 pieces per hour. Automatic sizing unit maintains consistency within 0.0002 in. from bore to bore.

Barnes Drill Co, 830 Chestnut St, Rockford, Ill

MORE DATA? Circle 56, inside back cover

Portable Instrument Identifies Alloys and Metal Properties

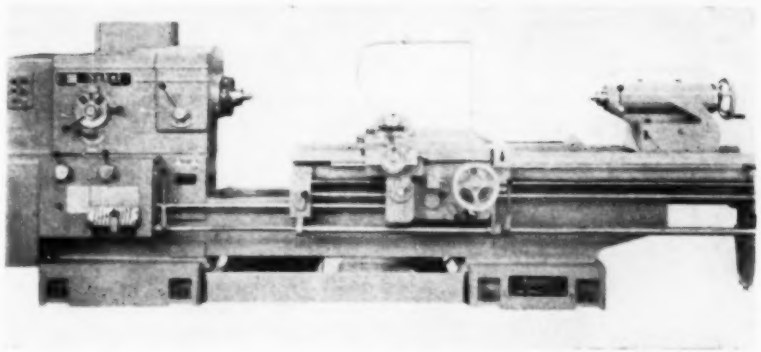
Transistorized conductivity - permeability meter rapidly sorts mixed lots of metal parts and tests for such properties as heat treatment condition, relative hardness and strength, chemical purity, and decarburization.

Measurements can be made on any flat surface ⅝ in. dia or larger, even when the surface is rough, dirty, or covered with layers of paint. Measurements are made in about three seconds by touching a hand-held probe to the surface being tested. The probe generates an electro-magnetic field which excites eddy currents in the test part. Instrument response to conductivity and permeability is displayed on a meter and two alarm lights signal conditions above and below preset tolerances. Special probes can be supplied for curved surfaces.

A variety of plug-in meter scales is available for different metals and conductivity ranges. The operator only has to calibrate the scales. The unit is highly sensitive to hardness difference of a few points Rockwell or slight alloy differences. It uses printed circuits, is battery operated and weighs 5½ lbs.

Metrol, Inc, 17 E Holly, Pasadena, Calif

MORE DATA? Circle 57, inside back cover



Combination Engine-Extension Gap Lathe Offers 18 Spindle Speeds up to 1500 rpm

Dual-purpose heavy duty lathe, made by Nebel Machine Tool Corp of Cincinnati, can operate as an engine lathe with 26½-in. swing over bedways, or as an extension gap lathe for large, odd-shaped parts, with 46-in. swing through the gap. By opening the gap, distance between centers can be increased from 48 to 84 in.

Lathe offers 18 speeds ranging up to 1500 rpm, selected from a direct-reading color index and controlled by two levers and color keyed plates. Heavy duty quick change box provides 60 feeds, from 0.0027 to 0.192 in., and 60 thread changes, from 1 to 72 tpi, including standard pipe threads. Up to 20 hp is supplied by a constant speed main drive motor through a multiple disc clutch and brake mounted externally on the headstock.

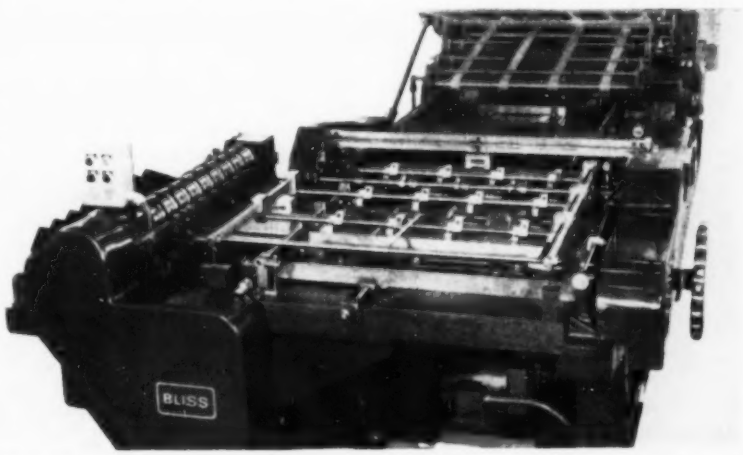
The three-bearing spindle is mounted at the front and center supports on zero precision, angular tapered roller type bearings. At the rear, the radial type third bearing provides for longitudinal spindle expansion.

Bed construction consists of combination box girth and diagonal ribbing on the sliding upper bed, and V and flat ways between the upper and lower bed. The upper bed is moved along the lower bed by a screw located in the center of the bedways. This assures perfect alignment between the upper and lower bed when positioning and stop chips from entering between the two bedways.

The lathe's gap type carriage permits facing of the full swing capacity through the gap in one cut without resetting the cross slide.

Nebel Machine Tool Corp, 3401 Central Pkwy, Cincinnati 25, Ohio

MORE DATA? Circle 58, inside back cover



DUPLEX SLITTER is capable of processing 44 x 44-in. sheets at 30 to 35 sheets a minute as a body blank slitter and at higher speeds as a squaring slitter. It can be used for either lithographed or plain sheets—*E W Bliss Co, Container Machinery Div, 1375 Raff Rd, SW, Canton, Ohio*

MORE DATA? Circle 59, inside back cover

Gear Deburring Machine Handles Spur, Helical and Bevel Gears

Redin gear deburring machine is a semi-automatic, self-contained unit designed to remove machining burrs economically from spur, helical and bevel gears.

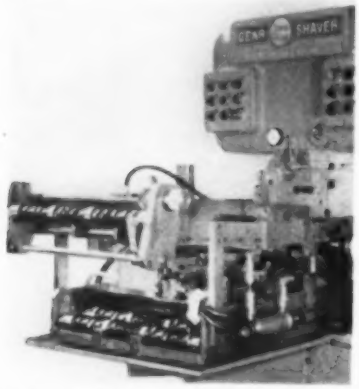
The work spindle rotates the gear at the desired speed and the floating wheel spindle allows the wheel to follow the gear tooth profile automatically. It deburrs the entire form. No change gears followers or templets are required. This operation can be performed regardless of the Brinell hardness of the gear.

The machine is said to eliminate high cost wheel dressing or cutter maintenance.

It can handle gears up with faces to 6 in. Work speed is 1 to 5 rpm. Wheel speed is 11,000 rpm; wheel size is 3 in. dia by $\frac{1}{8}$ in. face.

Redin Production Machine Co, 2433 20th St, Rockford, Ill

MORE DATA? Circle 60, inside back cover



Automatic Loader Handles Long Parts on Gear Finishing Units

Red Ring slide-type fully automatic loader, featuring an air-cushioned exit motion and an air-powered steadyrest, handles long slender parts on gear honing or finishing machines.

Parts such as automotive camshafts are loaded into the inlet magazine and pass through a pair of gaging master gears to check for oversize dimensions. The gears are spaced by a series of linkages that advance each shaft part as one is fed into mesh with the cutter or honing tool.

Air powered head and tail stocks advance centers into each end of the shaft in the meshing position. A steadyrest is raised to contact one of the bearings in the middle of the camshaft and is locked in position while the gear teeth are being finished. When finishing is completed, an air cushioned mechanism lowers the camshaft into the exit chute.

National Broach and Machine Co, 5600 St Jean, Detroit 13, Mich

MORE DATA? Circle 61, inside back cover

Forming Brake Features Undercut Box Fingers, 1-in. Top Opening

Box finger brake with 24-in. forming width is said to be particularly applicable for forming boxes, cabinets, chassis, and panels with up to 1-in. lip or flange on top or bottom.

Called the Di-Acro Model 24, the four-in-one machine performs as a box and pan brake by arranging the box fingers in proper combinations; bar folder or standard folding brake with all the box fingers in position; radius former by moving the finger mount bar up to $\frac{1}{8}$ in. back from the centerline; open-end former by installing an open-end finger accessory in place of the box fingers.

Undercut box fingers and 1-in. clearance through top opening enable material as heavy as 16 gage mild steel sheet to be formed into boxes and chassis as deep as 3 in. and with up to a $\frac{1}{2}$-in. lip. Maximum bending angle for one operation is 135°.

O'Neil-Irwin Mfg Co, 512 8th Ave, Lake City, Minn

MORE DATA? Circle 62, inside back cover

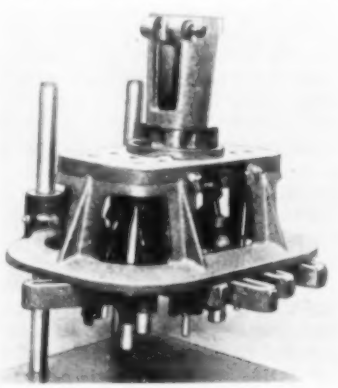
Vibrating Machine Designed for Mass Production Finishing

Vibratron has been developed for mass production cleaning, descaling, deburring, radiusing, fine finishing, and coloring of metal parts. Unlike conventional barrel finishing where abrasive action takes place in a sliding zone only several inches deep, work zone in the Vibratron extends throughout the entire abrasive mass. Complex cast, forged, stamped, and machined parts with shielded and internal surfaces can be processed. Time cycles are very short. Rate of production is reported to be up to 1000% greater than conventional barrel finishing techniques.

Vibration is induced by a system of eccentric weights integrally mounted with the vibrating motor. Motor is mounted directly onto the bottom of the vibrating tank. Additional features include pushbutton controls and an acoustical housing.

Roto-Finish Co, Kalamazoo, Mich

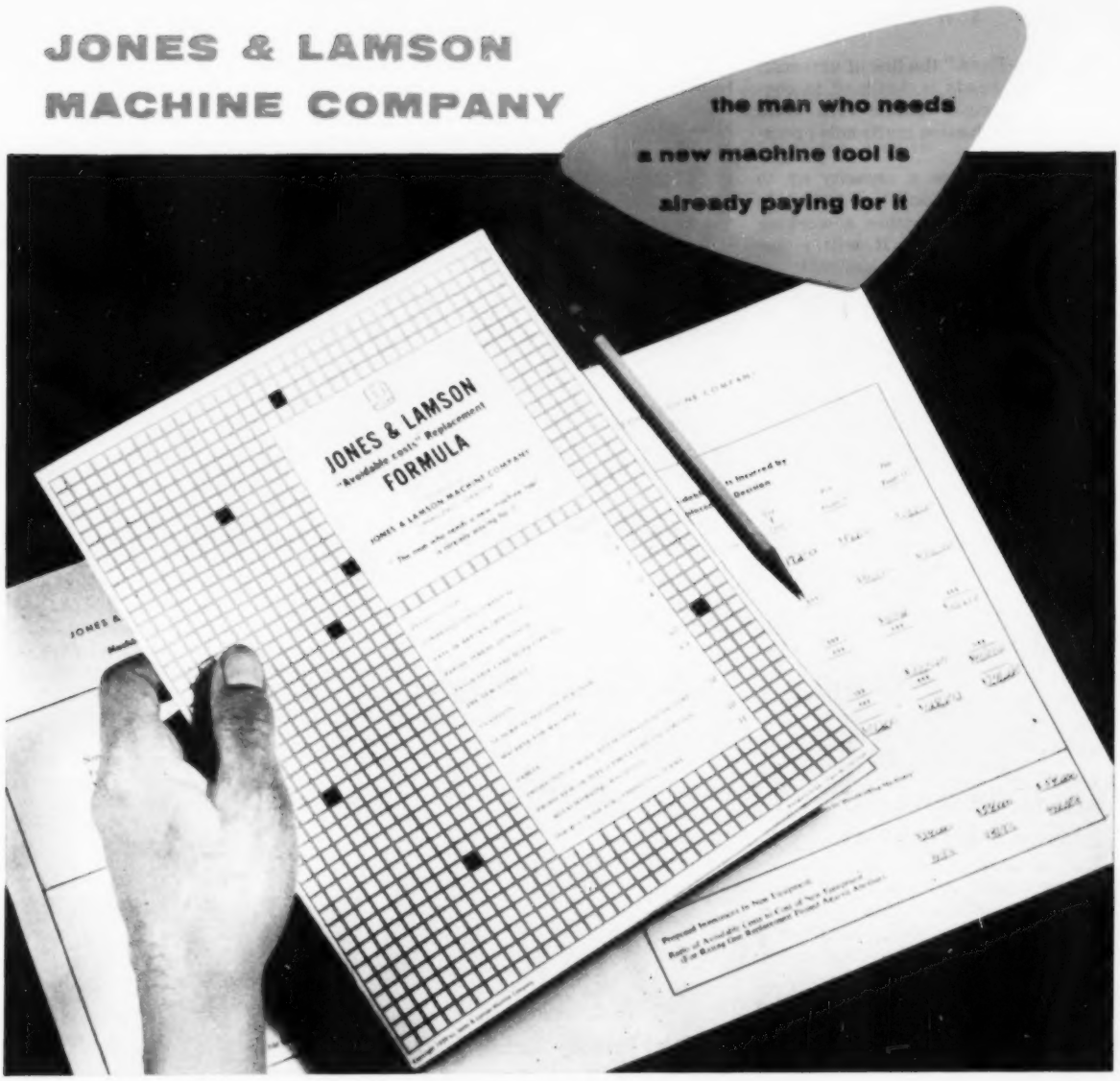
MORE DATA? Circle 63, inside back cover



Adjustable Spindle Head Offers Greater Work Area, Flexibility

Model 1100 adjustable spindle drilling and tapping head is more flexible and offers a larger work area than previous models. Known as

JONES & LAMSON MACHINE COMPANY



How to get Equipment Dollars from Management

To management men, nothing speaks so eloquently as facts. Take the men in *your* front office, for instance. When told that a new machine tool (or several new ones) is a "must", they may very well be inclined to agree. But they have to be *shown*.

In order to sell management, you must present an accurate, factual statement, comparing current productivity of existing equipment, with the productivity attainable with new, advanced equipment.

And this is where you must exercise extreme caution.

Why?

Because, practically without exception, the formulas commonly used for evaluating machine tool performance contain flaws, fallacies and limitations which are seriously misleading. They give an erroneous picture because they distort the facts.

Happily, J & L has the answer to this problem. It's the new J & L "Avoidable Costs" Replacement Formula, which gives you an easy, step-by-step method of productivity evaluation which is logical, accurate and reliable. This formula is tried and true. It gives you a clear, true picture and supplies you with the facts you need in order to get that new machine you're looking for.

For your copy of J & L's "Avoidable Costs" Replacement Formula, together with easy-to-use work sheets, write Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

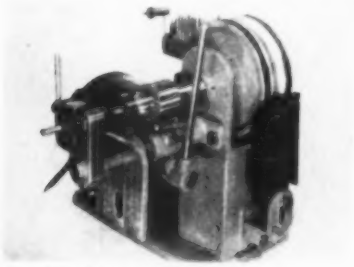
"Knuckle-Head," the line of universal ball joint heads is designed to convert any single spindle drill press for high-production multi-hole operation.

This model has a capacity up to 5/16 in. in steel and can be set to any hole pattern within a working area of 6 x 12 in. It will either drill or tap by using easily interchangeable Ettco face plates.

Guide bushings are provided in the gear case for extra rigidity and alignment when guide rods are required. Aluminum templets, jig bored to requirements, can be supplied instead of spindle locating arms when a fixed spindle setup is required.

Ettco Tool and Machine Co, Inc, 594 Johnson Ave, Brooklyn 37, N Y

MORE DATA? Circle 64, inside back cover



Hand-Fed Power Threader Performs a Variety of Jobs

The Sensi-Threader performs common drillpress operations in metal or plastics. Uses include hand threating and tapping; precision under-sizing of threads to be electro-plated; chamfering; deburring; countersinking; stud-threading; reaming and spot facing; and shaving off build-up of plating material. Hand-feeding provides sensitiveness for experimental work, short runs, and for delicate threading and tapping jobs. With simple holding fixtures on the workplate, castings, stampings, moldings, and machined pieces can be threaded on a production basis. It can also be adapted for fast assembly work with a spindle non-reversing attachment, using tools such as screwdrivers, hex keys, and nut sockets in the Jacobs chuck. Operating speed is approx 700 rpm.

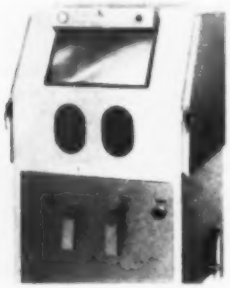
Model B taps up to ¼ in. steel; Model D to 5/16 in.; Model F to ½ in. Available attachments include precision alloy steel die holders for 3/16-in. steel rod. Unit occupies max bench space of 16 x 18 in., weighs from 42 to 47 lbs., depending on model.

Sensi-Threader Sales Co, 4820 49th Ave, SW, Seattle 16, Wash

MORE DATA? Circle 65, inside back cover

CARBURETOR PADS on three different truck engine intake manifolds are milled, drilled, countersunk, spotfaced, and tapped at the rate of 109 pieces per hour by this five-station rotary index machine. Design features include: a two-position drill unit with two-position single-spindle drill head; interchangeable pot heads; a two-spindle tap head using one spindle at a time to tap a part *—Snyder Corp, 3400 E Lafayette, Detroit 7, Mich*

MORE DATA? Circle 66, inside back cover



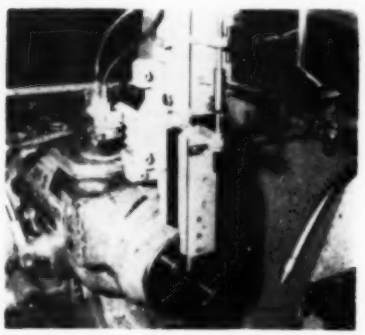
Glass-Jet Peening Machine Improves Finishes to 4 mu rms

Model A-50 uses specially treated minute pure glass beads in a slurry solution for peening, cleaning, and finishing surfaces. New process reportedly increases strength and fatigue life of metals. Masking is not required down to and including a 4mu rms finish. Additional features include no imbedment or contamination of material surfaces; elimination of further operations; extremely delicate parts can be peened without altering critical b/p dimensions; hinged and feather burrs can be removed.

Welded stainless steel unit is operated by a knee lever for manual freedom; s cond knee lever washes a 17 x 24-½-in. observation window. Holes in doors on each side of the working chamber permit peening long or bulky pieces. All components are installed in a cabinet fitted with standard plumbing and power connections.

Perfecto-Peen, Division of Aero-Test Equipment Co, PO Box 10627, Dallas 7, Texas

MORE DATA? Circle 67, inside back cover



Automatic Cut-Off Tool Offered For Ram-Type Turret Lathes

This automatic cut-off tool for ram type turret lathes is said to eliminate hand traversing of cross slide, provide an additional station on the turret, increase production up to 75% on cut-off operations, reduce operator fatigue.

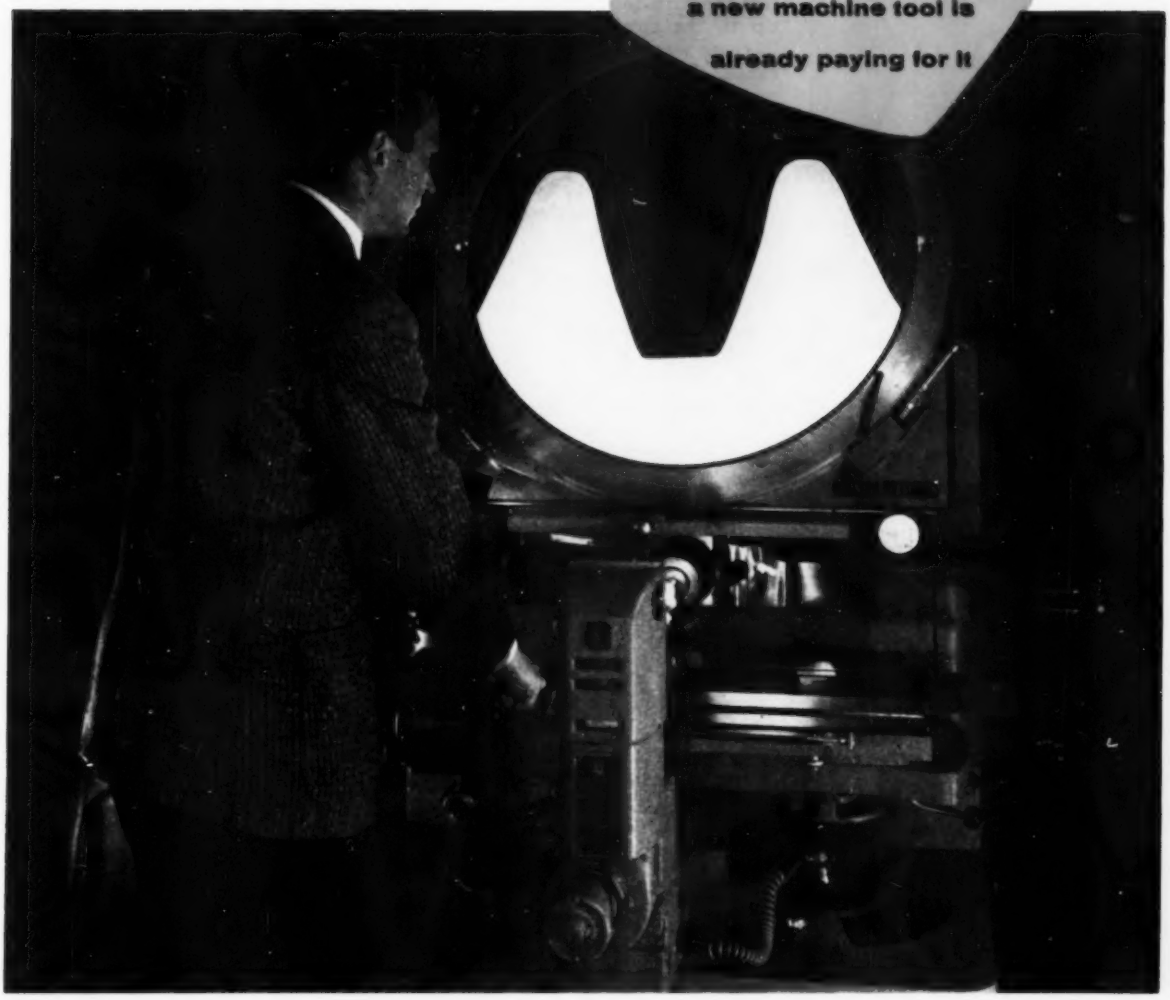
It has variable feed adjustment from 0 to 120 ipm and can be swung aside when not required.

Lloyd Tool Corp, 3330 E Colorado St, Pasadena 1, Calif

MORE DATA? Circle 68, inside back cover

JONES & LAMSON OPTICAL COMPARATORS

the man who needs a new machine tool is already paying for it



This revolutionary new light source makes optical inspection more efficient than ever

Jones & Lamson now offers the J & L Mercury Arc Lamp, an entirely new light source unit that gives *more than 5 times the intensity of the best filament light source available today.*

This new unit, designed for use with any J & L 14-inch or 30-inch screen Comparator, actually gives a *new* kind of light . . . an extremely bright, *steady* arc, with *no* flickering. Its high intensity produces an incomparably bright screen with razor-sharp black shadow, even at highest magnifications.

Thus, you can greatly increase the accuracy of your inspection and measuring with the J & L Comparator, even to the point of actually "splitting tenths". (For use at low magnifications, the light can be filtered readily.)

The J & L Mercury Arc Lamp comes as a complete, compact packaged unit, which plugs into any 110 volt outlet. It is quickly interchangeable with the standard light source of any Jones & Lamson 14-inch or 30-inch screen Comparator, and is a universal device which accomodates various standard makes of mercury arc lamps.

For detailed information and specifications, or a demonstration, contact your local J & L representative or write direct to Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

Miniature Portable Gun Welders Designed for Use on Honeycomb

Miniature portable gun spot welding unit, which operates hand powered and air powered welding guns, is designed for use on honeycomb panels; face sheets and skins, light stainless steel structures, and core splicing.

The portable power and control unit includes a synchronous weld timer panel with phase shift heat control and thyratron tube contactor; 220 or 440-v main power supply line; tap switch with eight heat selections; 10 kva transformer.

Air operated pincer-type guns have built-in air cylinders; replaceable electrode holders; easy-trip trigger switch; tip force of 25 or 40 psi (depending on model) at 90 psi; weight of 24 or 30 oz.

Push-type hand has watercooled body; adjustable spring pre-set electrode force; automatic trip built-in initiating switch; aircooled cables; quick-replacement $\frac{1}{8}$ or $\frac{1}{4}$-in. tips; weight of 14 oz.

A P Seedorff and Co, Inc, 3617 Cecelia St, Bell, Calif

MORE DATA? Circle 69, inside back cover

Unit Applies Carbide Coating To Cutting Surface of HSS Tools

Wickman Impregnator applies either a coarse or fine layer of specially formulated carbide to the cutting surface of HSS tools to increase tool life from 200 to 1000%, according to the manufacturer.

A localized sparking action transfers the carbide from the applicator tip to the cutting tool surface to increase wear resistance. This action causes the carbide to penetrate the metal of the tool and build up a layer of approximately 0.003 in. on coarse setting and 0.0005 in. on fine setting.

It can be used on such tools as drills, taps, dies, single-point turning tools, milling cutters, press tools, forging and extrusion dies. Three carbide tips are available: one with a chamfered end, one screw-driver type, one scriber point.

Dist by OK Tool Co, Inc, Milford, N H

MORE DATA? Circle 70, inside back cover

Dimension Inspection Air Gage Features 15-in. Gaging Range

Column-type Precisionaire dimensional inspection air gage features 15 in. of gaging range, claimed to be two to three times more than that of most similar instruments.

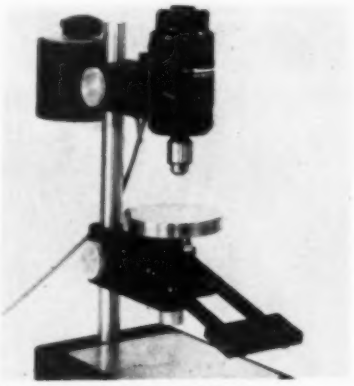
Single column instruments, designated Model 1500 Series, are available with standard amplification of 5000:1 or 10,000:1. A super amplification kit for use with the 10,000:1 instrument provides amplifications of 20,000:1 40M, 50M, 80M, and 100,000:1 without changing the glass column.

At 5000:1 amplification, the instrument has an inspection range of 0.003 with scale graduations in 50 millionths. At 100,000:1 amplification, range is 0.00015 with 2 millionths graduations.

The longer gaging range also permits a larger number of part sizes to be classified within a given range.

Sheffield Corp, Subsidiary of Bendix Aviation Corp, Dayton 1, Ohio

MORE DATA? Circle 71, inside back cover



Sensitive Drill Press Has No-Load Speed of 16,000 rpm

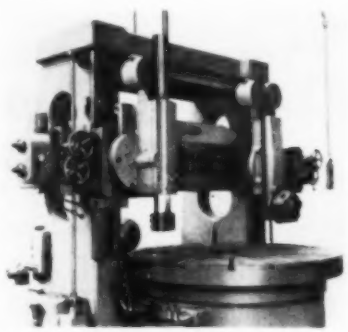
This small, sensitive drill press is designed to be used as an independent unit, or as an accessory to the Milman T-100 Lead Screw Tapping Machine. It has a powerstat controlled 110-v ac motor that develops $\frac{1}{4}$ hp at 5000 rpm and has a no-load speed of 16,000 rpm.

Drill capacity is 0 to 5/32 in. dia using a Spiro keyless, balanced chuck. The unit can drill to the center of a 12-in. dia circle. Maximum distance between drill chuck and worktable is 6 in. Work is brought up to the drill by vertical movement of the counterbalanced 5 in. dia worktable, which has a maximum travel of $1\frac{1}{4}$ in.

As a complete unit the drill press costs $198. As an attachment for the tapping machine (less column, base and powerstat control) it costs $158.

Milman Engineering Co, 1831 Pontius Ave, Los Angeles 25, Calif

MORE DATA? Circle 72, inside back cover



Vertical Boring and Turning Mill Line Has 5-10-ft Tables

Broadbent (British) heavy duty vertical boring and turning mills are available in four sizes, with tables of 5, 6, 8, and 10-ft dia. The heads, which operate independently, can be swivelled to a 45° angle. Left hand

JONES & LAMSON TURRET LATHES

the man who needs a new machine tool is already paying for it

Single point threading to a finish of 15-20 RMS is completely automatic–and fast

The I. D. of these large cap-nuts is approximately 5 1/4". The material is High Chrome Nickel Steel, Rockwell C 30–32. The thread is 8 pitch, 5 1/2" long, *and tapered .005" per inch.*

It's a tough job to make time on, but a J & L Turret Lathe equipped with an Auto-Threader, does the threading in 5 minutes!

Here's how: The part is faced and a rectifying bore is made; in the same chucking, threading is completed in 16 automatically-controlled passes, with a graduated cutting depth for each pass. *Pitch diameter is held to .002",* and finish is 15–20 RMS on the flanks.

On the old machine, milling the thread alone took 75 minutes. With this new setup, the entire operation — including loading, facing, boring, threading and unloading — is only 15 minutes.

Jones & Lamson Turret Lathes are available with: Completely automatic controls; 45°, 60°, and 180° Tracers; taper attachments, and a variety of other tooling complements, all designed to increase productivity.

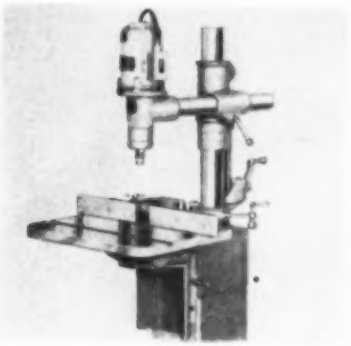
Write for detailed information, Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

unit is fitted with a forged steel octagonal shaped ram; the right hand unit with a pentagon turret. Six feed changes, from 4 to 96 cuts per inch, are available vertically, horizontally, or angularly. Twelve table speeds range from 1¼ to 31 rpm.

Barer Engineering and Machinery Co. Ltd, Box 1180, Montreal, Canada

MORE DATA? Circle 73, inside back cover



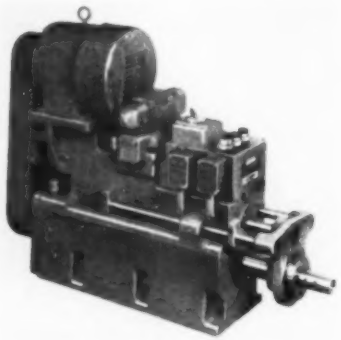
Triple-Purpose Machine Performs Routing, Shaping, and Carving

Stationary power tool for light metal (nonferrous) processing can be converted in 30 seconds for any of three operations by switching the motor unit. Features include automatic lock, crank-type head raising and lowering mechanism which permits fast positioning of motor unit for variations in depth of cut; spindle speed, without load, 20,000 rpm; chuck capacity for routing ¼-in. bore shaping cutters; worktable measuring 18 x 14 in. with 20-in. fence, 2¼ in. high.

Standard equipment includes collet chuck for ½-in. shank bits (plus sleeve collets for ¼, 5/16, ⅜-in. dia bits); carving spindle; shaper adaptors for 5/16 and ½-in. bore cutters; six guide pins ⅛ to ½ in.; four wrenches; shaper guard and fence. Price of 110-v model is $410.

Duro Metal Products Co, 2651 N Kildare, Chicago 39, Ill

MORE DATA? Circle 74, inside back cover



Lamb Announces Self-contained Quill-Type Hydraulic Power Unit

This self-contained quill-type hydraulic power unit is made up of standard components which are normally carried in the user's inventory or the supplier's stock.

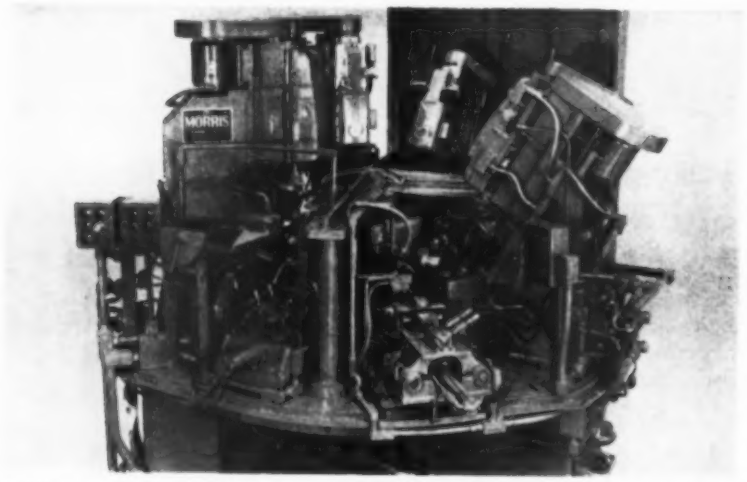
The unit rotates and feeds drills, reamers, counterbores and spotfacers singly or in multiple. It can be used as a driver to perform boring, milling and similar operations. It can be mounted at any angle from the vertical and can be operated by hand or automatically from a remote position.

Maximum spindle thrust is 2455 lbs at 500 psi. Total stroke is 12 in. with 4-in. feed stroke adjustable from 1.5 to 180 ipm. Spindle speed is 4560 max when driven by an 1800-rpm electric motor.

Other features include variable delivery hydraulic pump, manifolded hydraulic components, automatic lubrication, adjustable spindle speed.

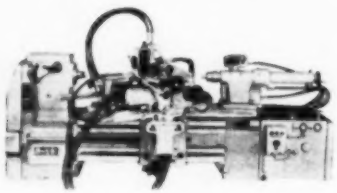
F Jos Lamb Co, 5663 E Nine Mile Rd, Detroit 34, Mich

MORE DATA? Circle 75, inside back cover



PLANET PINION CARRIERS are automatically loaded, drilled, fixture-indexed and unloaded on this Morris High Production Machine, Model 328-S, an 8-station unit that utilizes a 30-in.-dia. horizonal rotating table to process 600 parts (5¾-in. dia x 1⅜ in. thick) per hr—*Morris Machine Tool Co, 2011 Eastern Ave., Cincinnati 2, Ohio*

MORE DATA? Circle 76, inside back cover



Flow Forming and Spinning Lathes Use Building Block Construction

D35 Series of Bokoe (German) spinning and flow forming lathes uses building block construction. By adding various accessories to the hand operated machine (above), it is possible to construct a variety of models, including the Hycoform (below), a heavy-duty, hydraulic, semi-automatic copying machine designed to mass-produce nose cones, cylindrical and tapered parts.

At constant output, spindle speeds are 45 to 1200 rpm, steplessly adjustable through hydraulic drive. Start, stop and speed selection are remote controlled.

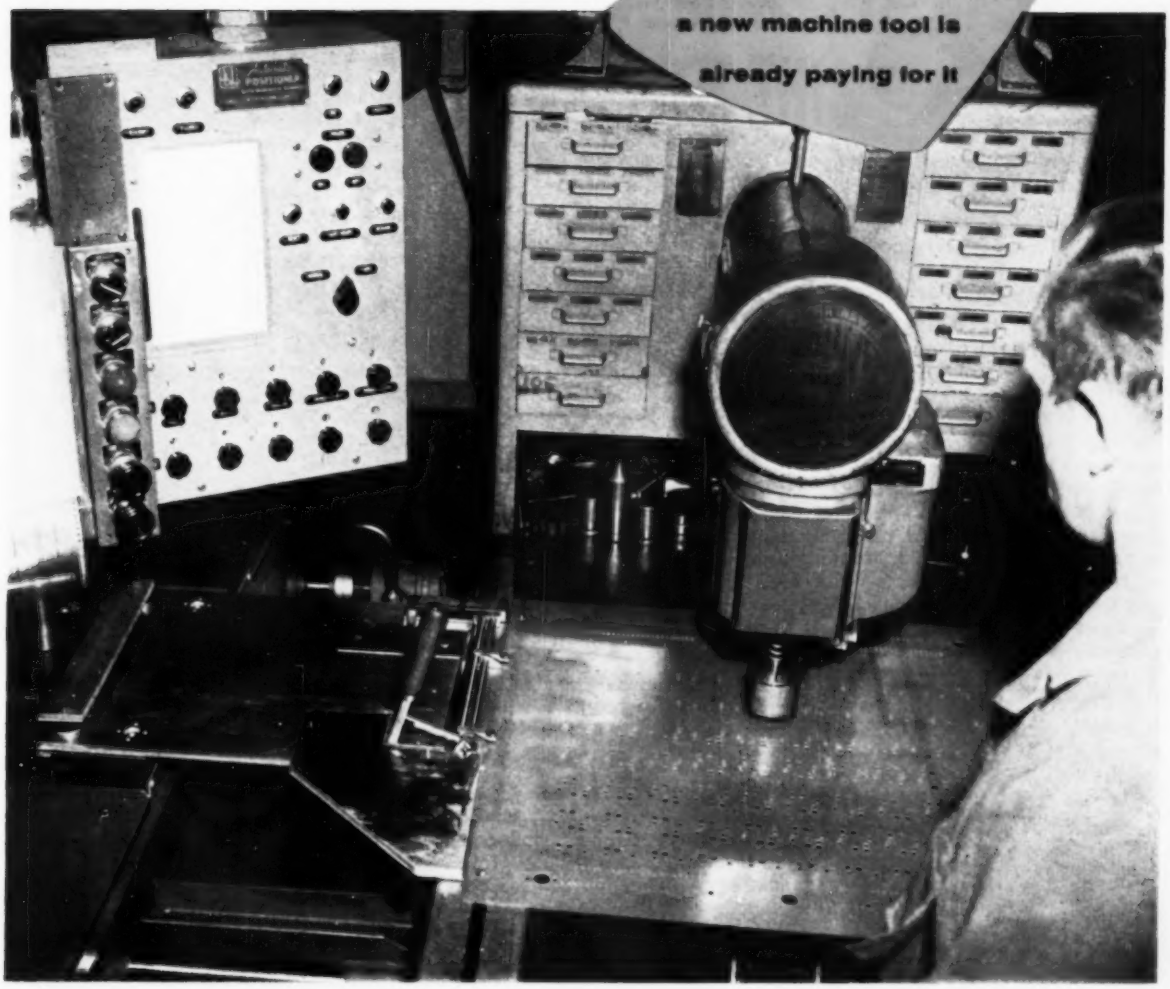
A second saddle can be added at the rear with cross slides on a rotary base and with attachments to form complex parts. The Bokoe will flow form aluminum up to ⅜ in. thick and steel up to ¼ in. Maximum swing, 28 in.; longitudinal slide travel, 16 in.; cross slide travel, 6 in.; center distance, 42 in.; main motor drive, 7½ hp.

Imported by Cosa Corp, 505 Lexington Ave, NY 17, NY

MORE DATA? Circle 77, inside back cover

JONES & LAMSON
"AUTOMATION"

the man who needs
a new machine tool is
already paying for it



This Tape Controlled Setup Punches 1483 holes – of 11 different sizes – in just 85 minutes

How's this for small lot automation? The problem is to produce 50 parts, each having 1483 holes of 11 different sizes. Hole location must be ±.002". Delivery — 2 weeks.

J & L's numerical control positioning table, applied to a standard punch press, does the job with minimum lead time, production time, and cost. Here's how:

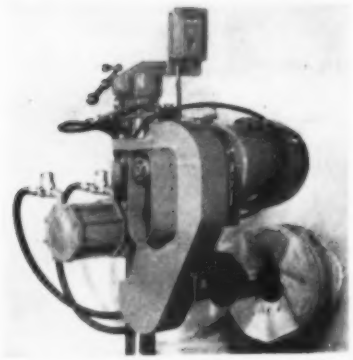
The entire tape programming for this complicated part takes only 15 hrs. There are no fixtures, templates, or dogs to be made and set. No gang tooling to prepare. No appreciable setup time.

The operator simply inserts the prepared tape, locates the work piece and pushes a button. The positioning table is then automatically controlled in any pre-arranged, random pattern. Therefore there are only 11 tool changes for the 11 sizes of holes. And — this unit tells the operator when and what tool to change.

A completed part comes off the machine every 85 minutes. Changeover for other jobs is just a matter of changing tapes and tools.

Investigate how tape control can help increase the efficiency of *your* operation. Write to Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



Universally Adjustable Spindle Stand Oscillates Automatically

Universally adjustable spindle stand is equipped with an air cylinder which provides automatic oscillation to eliminate streaks or pattern.

This unit can be used with Vonnegut brush backed heads, buffs, wire brush, or other type polishing wheels. It has vertical and 360° rotating adjustment. Variable speed range is 600 to 1800 rpm, or 1200 to 3600 rpm. The stand can be used for short run hand fed operations or installed with a powered conveyor system.

Grinding and Polishing Machinery Corp, 2530 Winthrop Ave, Indianapolis 5, Indiana

MORE DATA? Circle 78, inside back cover

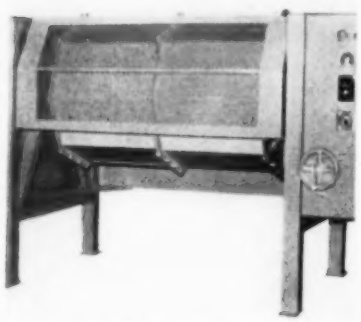
Air Powered Pencil Grinder Has High Speed Under Load

The Model M1223, D-03 pencil grinder, which can be used with carbide cutters, burrs, mounted points, and drills, has a powerful bladed air motor that provides high speed under load. Applications include die touch-up work, pattern work, and jobs requiring precision control with a reserve of power for metal removal.

Among its features are a rubber flex collet that minimizes run-out to 0.002 in., spline drive from rotor to spindle, sleeve type metering throttle, and front exhaust. It weighs 12 oz, measures 1 1/32 in. OD and 5⅞ in. long with throttle, and operates at 40,000 rpm.

Rotor Tool Co, 26300 Lakeland Boulevard, Cleveland 32, Ohio

MORE DATA? Circle 79, inside back cover



Tumble-Finisher Has 21.7 cu ft Capacity Compartmented Barrel

This heavy duty tumble finisher provides 21.7 cu ft capacity in a multi-compartmented barrel for large scale production in parts finishing, grinding and deburring operations.

The Rampe Model 30 features "Floating Power" drive that eliminates chain and sprocket mechanisms and permits simple hand wheel speed changing from 8 to 25 rpm. A built-in magnetic brake provides full control.

Additional features include: interchangeable barrels with a choice of one to three compartments, vinyl-lined barrels, forward and reverse jogging switches, welded steel construction. Two barrel sizes are available: 30 x 32 in. and 30 x 48 in.

Rampe Mfg Co, 14915 Woodworth Ave, Cleveland 10, Ohio

MORE DATA? Circle 80, inside back cover

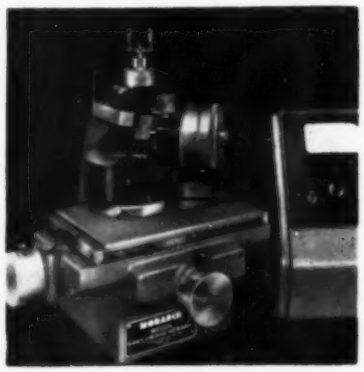
1-ton Capacity Work Positioner Tilts Through 105°

Model PM-1051, designed for positioning of heavy, odd-shaped work for welding or fabrication, will handle titanium and other super-alloy weldments weighing up to 2000 lbs. Its 32-in. table (42-in. optional) has six milled T-slots for jigs or fixtures to take a wide variety of shapes.

Table tilts from vertical position to 15° below horizontal. Desired tilt angle is set on the protractor, and the tilt button on the operator's control panel is depressed for momentary contact. Table stops automatically when work reaches pre-selected position. Table rotates through the full 360° in either direction. Rotation speed may be varied continuously from 0 to 4 rpm. Worm and gear drive transmits rotation power.

Boesch Mfg Co, Danbury, Conn

MORE DATA? Circle 81, inside back cover



Instrument Checks Accuracy Of Cutting Tool Edge Radius

The Monarch precision radius checking instrument checks the radius of a cutting tool edge to assure close tolerance machining of hemispherically shaped workpieces on contouring machines.

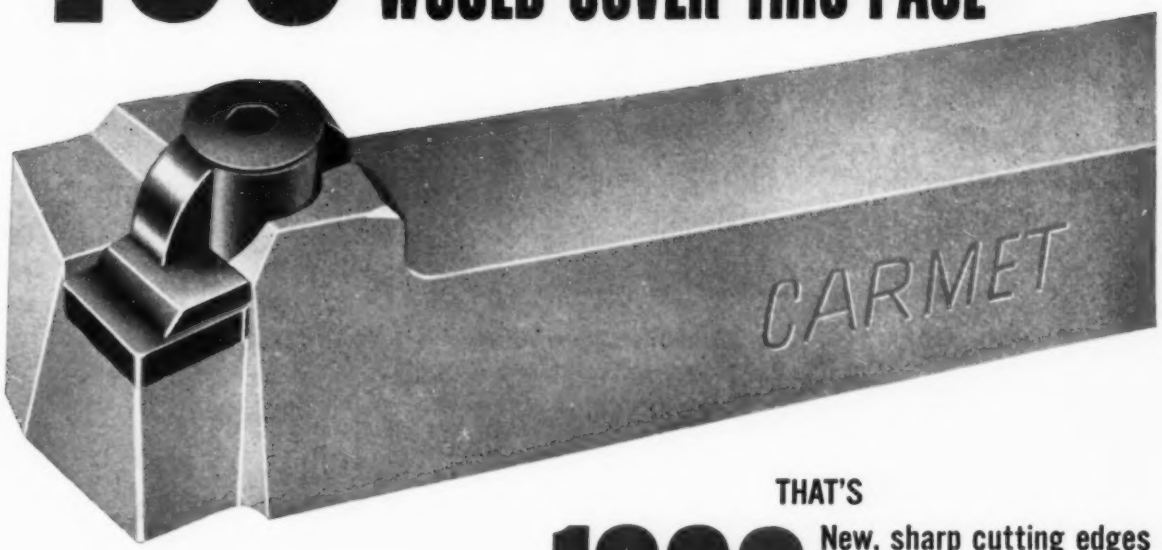
It consists of a main frame, a device for holding and positioning the measuring head, a device for mounting and adjusting the tool, and an electronic checking instrument (not supplied by Monarch). A direct reading oscillograph may be used to record tool contours.

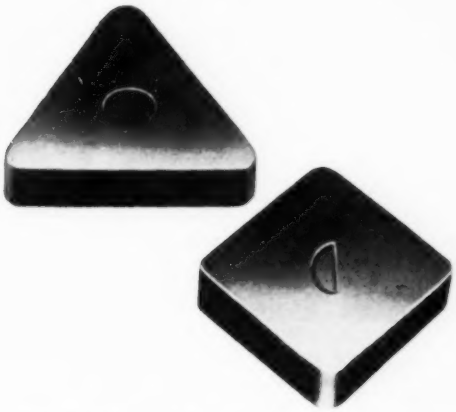
It works like this: The checking device is set by using one of five checking balls with radius corresponding to the tool nose radius to be measured. The tool is mounted in the tool slide holder and the axis of the upper slide holder is located through the center of the tool radius. If the radius dimension differs from that of the standard ball, the precision micrometer head is adjusted to determine the amount of error and the amount of deviation is shown.

Monarch Machine Tool Co, Sidney, Ohio

MORE DATA? Circle 82, inside back cover

165 CARMET INDEXABLE SQUARE CARBIDE INSERTS WOULD COVER THIS PAGE





THAT'S

1320 New, sharp cutting edges for about 10¢ each to do almost all metal cutting jobs

THEY'D REPLACE

1320 Individual, brazed single-point tools.
No tool regrinding.
Minimum tool changing.

Over 118 styles and sizes of Indexable Inserts to use in Carmet high-alloy, cadmium plated Tool Holders in both positive or negative rake types.

Write for new Catalog C-16

CARMET CEMENTED CARBIDES FOR INDUSTRY

This 32-page first edition contains prices and complete specifications on Carmet's full line of cemented carbide tipped tools, Indexable Inserts, blanks and holders. Speed and feed charts, grade comparisons and ordering information included.

ADDRESS DEPT. AM-20

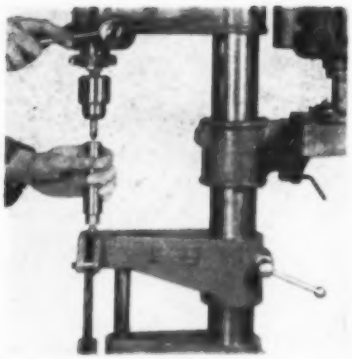
Why not find out more about Carmet Indexable Inserts and the complete line of Carmet cemented carbide tools and standard blanks? Your Carmet distributor carries them in stock, assures prompt delivery and will aid you in selecting the proper grades and styles to cut your metal-working costs. Call him today or write Allegheny Ludlum Steel Corporation, Carmet Division, Detroit 20, Michigan.

WBW-7323 A

CARMET

CEMENTED CARBIDE DIVISION OF
ALLEGHENY LUDLUM STEEL CORPORATION

AL



Centering-Lapping Attachment Fits Round Column Drill Press

Centering and lapping attachment for round column, floor-type drill presses is designed to center drill and lap centers to a uniform depth. Performing these operations on a drill press instead of a lathe is said to result in easier handling of parts, savings of setup time, and elimination of grit that would deposit in lathe dovetails and bed.

Attachment provides a diamond dressing tool for dressing lapping stones. It is mounted on a pivot and can be swung out of the way when not in use.

Alignment while making adjustment for various work lengths is maintained by a guide rod fastened in the top bracket. The guide rod slides freely in the lower bracket which is anchored to the drill press column.

Federal Machine Tool Co, Emmett St, Bristol, Conn

MORE DATA? Circle 83, inside back cover

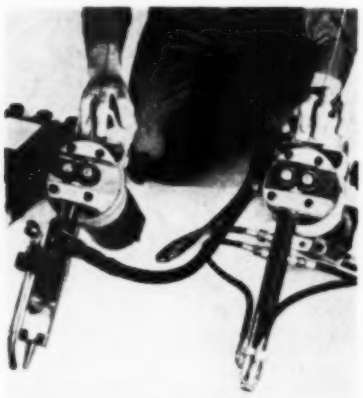
Cincinnati Offers Wider Wheels For No 3 Centerless Grinders

Cincinnati Filmatic No. 3 centerless grinders can now be equipped with either 15 or 20-in. wide grinding wheels to remove more stock per pass, increase feed rates, and reduce handling costs and grinding time.

On an operation where water pump shafts were being ground, a grinder with a 20-in. wheel removed as much stock in two passes as a grinder with a 6-in. wheel did in six. The No. 3 grinder with 20-in. wheel removed 0.011 to 0.013-in. of stock in one roughing pass at a feed rate of 22 fpm. The parts were finished with the second pass in which 0.001-in. of stock was removed at a feed rate of 37 fpm. Tolerances were held to 0.0003 in. for size, 0.000050 in. for roundness, 0.0001 in. for straightness and an 8 mu-in. surface finish.

Cincinnati Milling Machine Co., Cincinnati 9, Ohio

MORE DATA? Circle 84, inside back cover



Airco Offers New Welding Heads, Controls, Barrels

New equipment offered by Airco for use with its gas-shielded metal-arc process includes two Aircomatic heads, two controls, and two machine barrels.

The heads are single-motor-driven units designed primarily for CAV and RAV power sources using ferrous and non-ferrous aluminum and hard wires 0.030 to $\frac{1}{8}$ in. If only ferrous wires are used, they can operate from conventional dc power sources. They are equipped with thyratron controlled dc motors with constant wire feed speeds up to 600 ipm or 1000 ipm.

One control unit is a standard model complete with crater filler, meters, push buttons, gas and water solenoids. It operates on 230 v, single-phase, 60 c current. The other unit, operating on 115 v current, is designed for use in a common control panel.

Both machine barrels are rated at 800 amps dc continuous duty cycle. Model AM80-A is a water cooled unit with concentric shielding for all applications. Model AM80-B is an air-cooled unit with an external shield for high production CO_2 applications using only hard wire.

Air Reduction Sales Co, Div of Air Reduction Co, Inc, 150 E 42nd St, NY 17, NY

MORE DATA? Circle 86, inside back cover

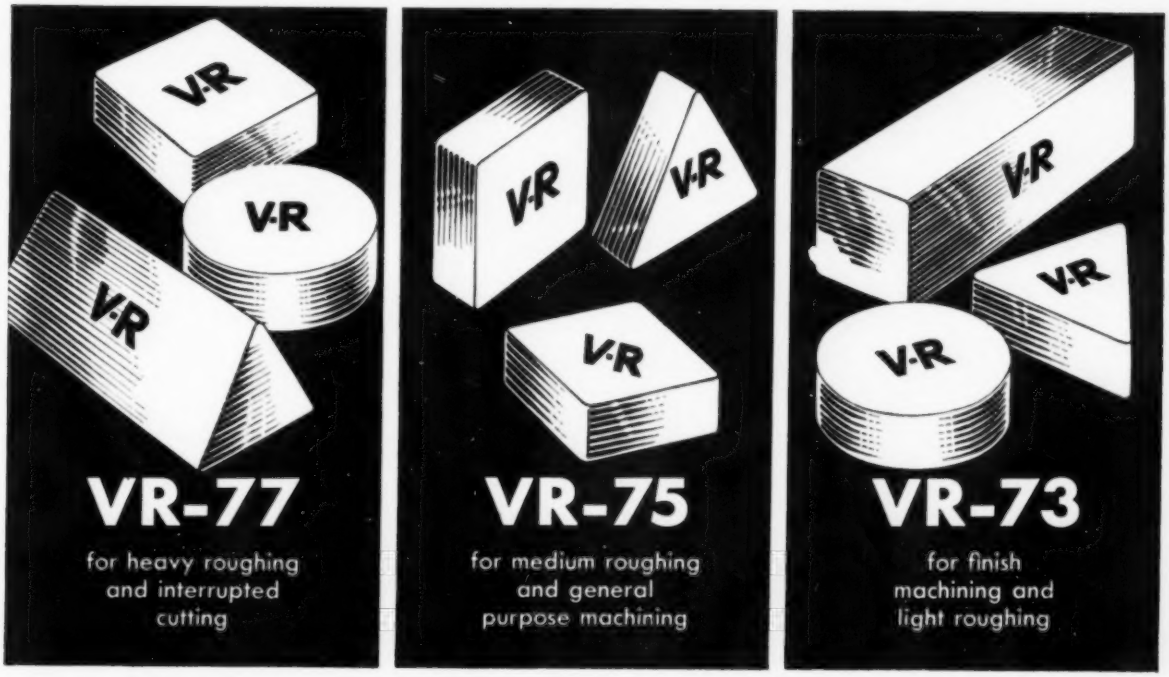
HYDRAULIC INDEX TABLE serves team of standard fixed-center vertical drilling machines which drill, ream, and chamfer connecting rod pin holes. Production is 600 parts per hour. All table components can be removed for service from the outside, without disturbing fixtures or table top—*Baker Brothers, Inc, 1000 Post St, Toledo, Ohio*

MORE DATA? Circle 85, inside back cover

You wouldn't play right field with a catcher's mitt . . .

playing ball or cutting steel,

use the "tool" designed for the job!



Each carbide grade has been specially engineered and field proven for the correct balance of wear resistance, shock resistance and heat resistance to handle a specific range of operations. These superior V-R carbide grades cover the complete range of operations for machining all types of steel and the new superalloys . . . setting new standards of carbide tooling performance in hundreds of plants. V-R engineers will be glad to help you select the carbide grade engineered for your job. Contact your nearest V-R representative or write for complete information.

Ask for Bulletin No. 5803 on V-R grades

V-R Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

C-744

840 Market Street • Waukegan, Illinois

NEW DI-ACRO 24-INCH BOX FINGER BRAKE

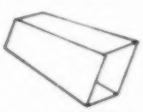
UNDERCUT FINGERS and one inch clearance permit forming chassis with up to ½-inch flange and clearing reverse bends from front of machine. New Quik-Set Micrometer Gauge instantly positions material for forming to die accuracy. This new 24-inch brake is designed for use in experimental labs, model shops and on short-run production.

Look for the name of your nearest Di-Acro distributor in the Yellow Pages under Machinery, Machine Tools . . . or write to O'Neil-Irwin Mfg. Co., for the fully illustrated folder.

1. BOX AND CABINET FORMER . . . forms all widths from ¾" to 24" by ¼" steps.

2. BAR FOLDER . . . folds or hems up to 16 gauge mild sheet steel across full width.

3. RADIUS FORMER . . . forms radii by positioning forming edge or with special radius fingers.



4. OPEN END FORMER . . . forms open end shapes by replacing box fingers with open end finger.

di-acro PRECISION METALWORKING MACHINES

Pronounced die-ack-ro

Find Us Fast in The Yellow Pages

O'NEIL-IRWIN MFG. CO.

405 Eighth Ave. • Lake City, Minnesota

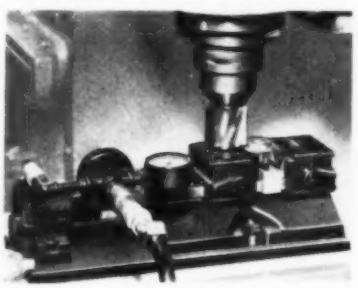
Weingarten Transfer Presses Available in New Line

Six models have been introduced ranging from 50 to 150 tons capacity and having from 5 to 10 tool stations. These automatic presses are fed from a stack of pre-cut blanks or a roll of strip material.

Units are equipped with individually adjustable pneumatic cushions for dies, with triple cylinders for each tool station. Adjustable transfer gripping device feeds parts from station to station. Presses can be equipped with an infinitely variable drive, and can be supplied with complete tooling.

Distributed by Cosa Corp., 405 Lexington Ave, New York 17, NY

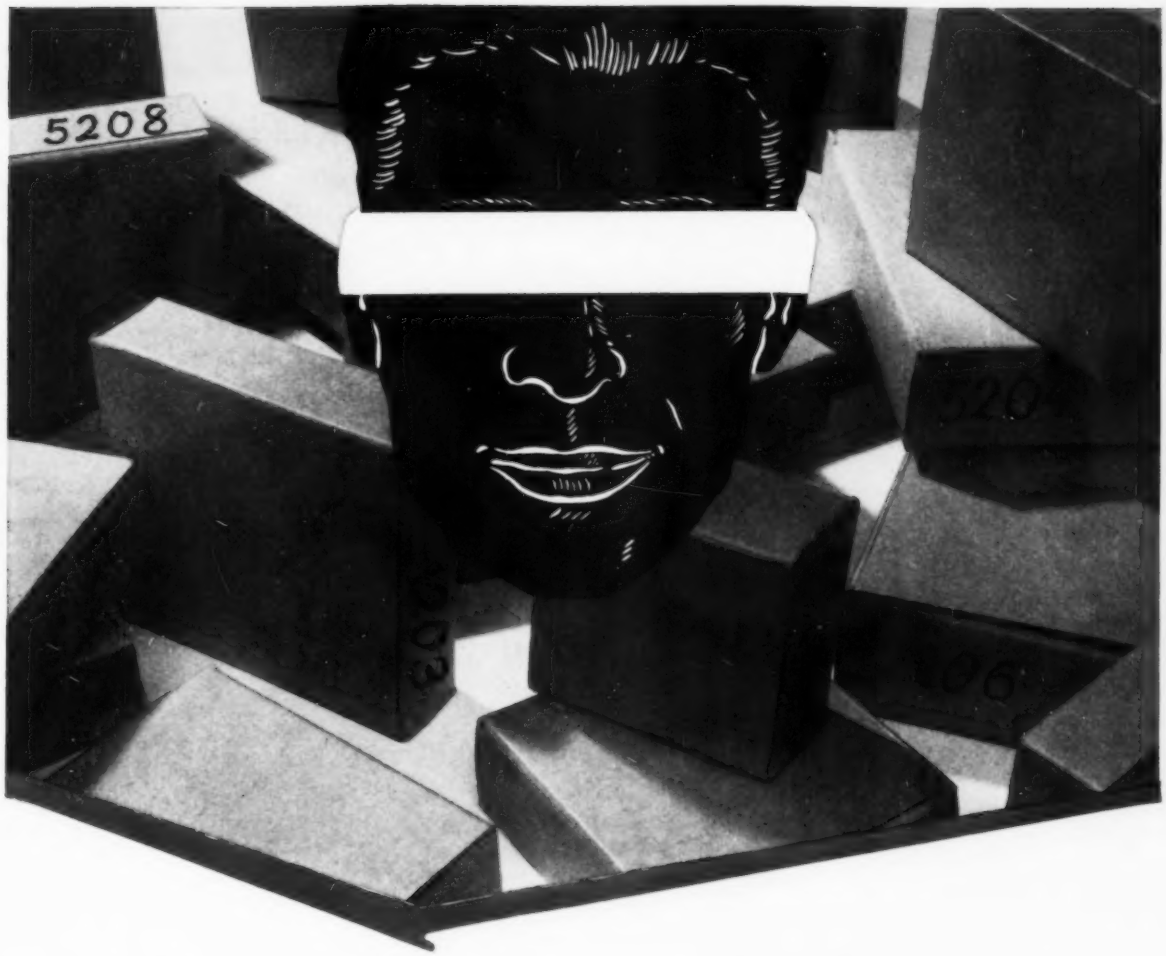
MORE DATA? Circle 88, inside back cover



Contour Grip Holding Fixture Designed for High Speed Production

Contour Grip can be actuated hydraulically, pneumatically, or through solenoid valves, and can be synchronized with the operation of any machine tool. It can be used as a conventional vise and as a single or multiple-jig fixture.

Holding principle is based on jaws composed of movable fingers which mold around the part to be held, no matter what its shape. When the jaws back off from the workpiece, the fingers remain in the same position as they were when gripping the part,



Don't buy bearings blindfolded . . .

Make certain the bearings you buy are in the manufacturers' original, sealed boxes . . . and avoid surplus or shelf worn bearings. These bearings are usually in plain boxes or individually wrapped and often are without any identification except for the bearing number.

If you are not getting "Factory Fresh" bearings you are not buying bearings incorporating the latest design and those which will give the longest life in your equipment. The one easy, certain way to get the bearings you want is to buy from Bearings, Inc.! We're *authorized* distributors for the many lines of bearings and accessories we sell—guaranteed by the manufacturers and Bearings, Inc. Our bearing engineers can recommend the best bearings for all applications and you will save time, trouble and money. Call the branch nearest you!

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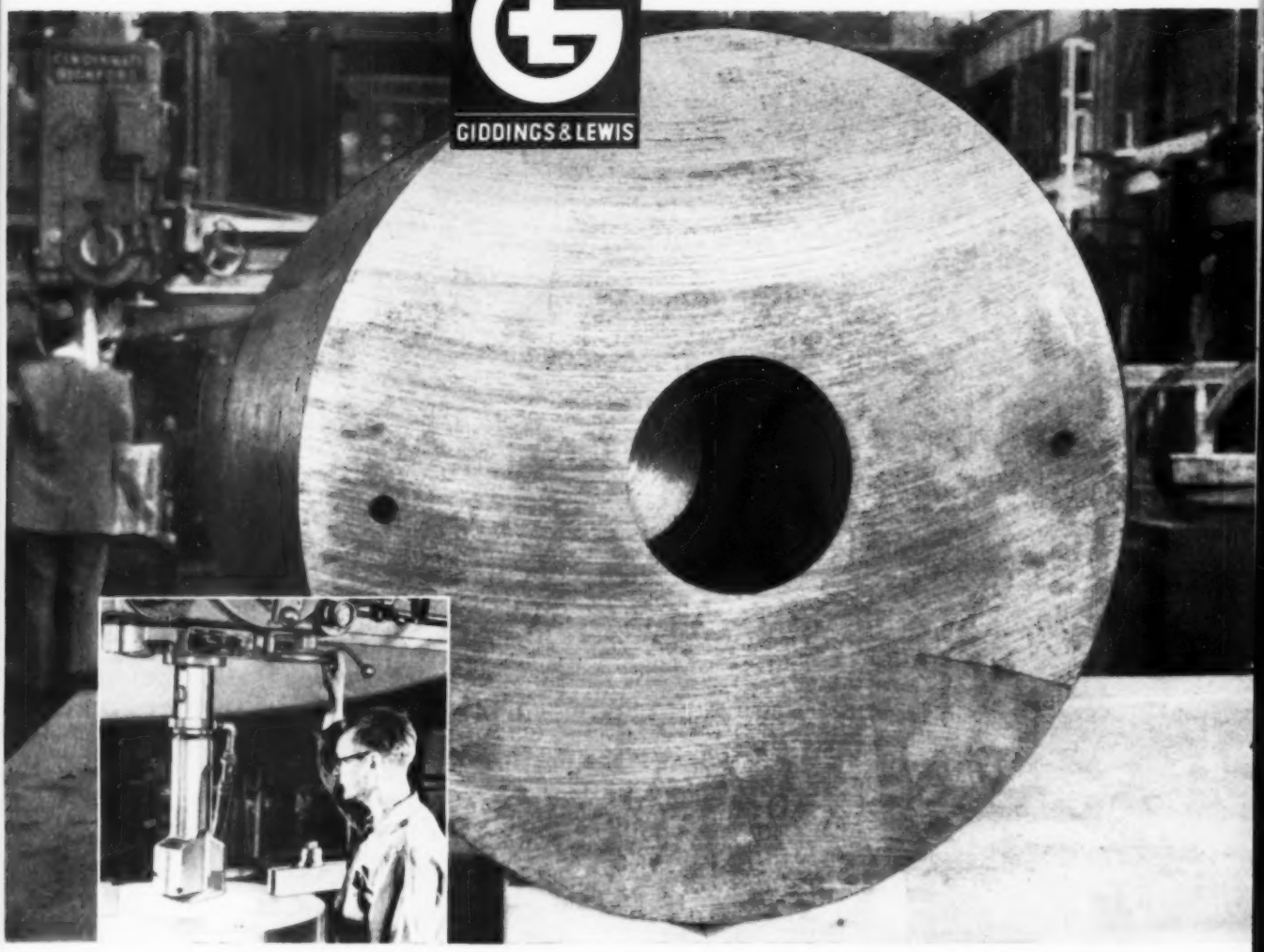
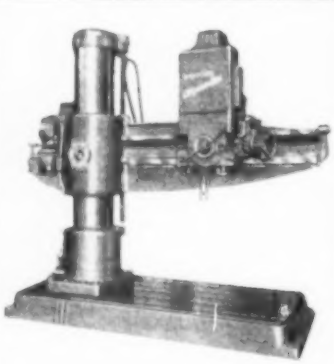


Chipmaster® radial drives 8″ spade drill in solid steel forging!



ALL-NEW CHIPMASTER®

the heavy-duty radial that does more than any before.

New Cincinnati Bickford Chipmaster radial drills have capabilities not approached by any other radial. The job above is a good example. An 8″ diameter hole, 18⅞″ deep, is spade drilled in solid SAE 4145 forged steel with a Brinell hardness of 200-240. The workpiece is a rolling mill drive coupling produced at Frank Kneeland Plant, United Engineering & Foundry Co., Pittsburgh. The machine is a 6′-19″ Chipmaster radial with a 25-hp motor.

The power, rigidity, and thrust capacity that enable the Chipmaster to handle this job will pay big dividends on any job. It means that you have the capacity to handle heavy drilling, boring, reaming, facing, trepanning, and spade drilling jobs. It means precision, accuracy, and maximum production. The Chipmaster can handle jobs now being done on slower or more costly machines.

For all the facts, call your Cincinnati Bickford distributor.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

CINCINNATI BICKFORD DIVISION, Cincinnati, Ohio

Giddings & Lewis also manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

CIRCLE 243 READER SERVICE CARD

High thrust capacity is key to capability of Chipmaster radial

You can't put too much thrust on a Chipmaster—and there's no vertical slop or backlash. The heavy-duty spindle rides on a quadruple bank of precision preloaded bearings. It never feeds away from its support—spindle, sleeve, and bearings move together.

The spindle sleeve travels in a 17½" honed head bore to provide rigidity for heavy feeds and accurate single-point boring. Both spindle and sleeve are heat-treated chrome nickel alloy steel. Spindle sleeve is hard chromium-plated.

Short, stubby column. Height over the Chipmaster column is up to 17⅞" less than that of other radials without sacrificing work height capacity. Column sleeve rides on precision preloaded bearings. This short, rigid column resists the deflection imposed by terrific thrust loads of heavy operations like that illustrated at the left.

Before you buy a radial, watch the all-new Chipmaster work.

Here's the chip that proves the difference

Ask your Cincinnati Bickford distributor to show you the big chip made at .100" feed, 45 rpm, with a 3" twist drill driven in solid steel by a Chipmaster radial! No other radial, regardless of size, can perform this feat.

symbol for

machining cost reduction

CB-111

CIRCLE 244 READER SERVICE CARD

so that the next piece can be dropped into position. All models are built in four standard sizes with max jaw openings from 1-9/16 to 6-⅛ in.

E W Bliss Co, Die Supply Div, 1400 Brookpark Rd, Cleveland, Ohio

MORE DATA? Circle 89, inside back cover

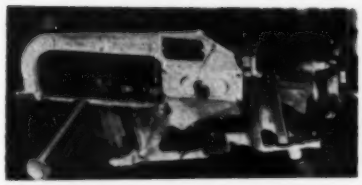
Plastic-Faced Hammer Has Replaceable Tips

One-piece die-cast aluminum-handled Safe-T Grip is available in two models, No. 15 (pictured) weighs 1 lb, has 1½-in. head diameter; No. 205, a 2-lb unit, has 2-in. head dia.

Full floating assembly allows relocating, repositioning, and rotating of the tips to equalize wear. Tips attach to Tip-bar that floats within the hammer. Tips are available in nylon or in plastic (medium, tough, extra-hard). Price of No. 15, with two plastic tips, is $3.60 fob.

R W Hughes Industries, Inc, 2713 Ludelle, Fort Worth, Texas

MORE DATA? Circle 90, inside back cover



Portable Power Hacksaw Cuts Solids and Thin Wall Tubing

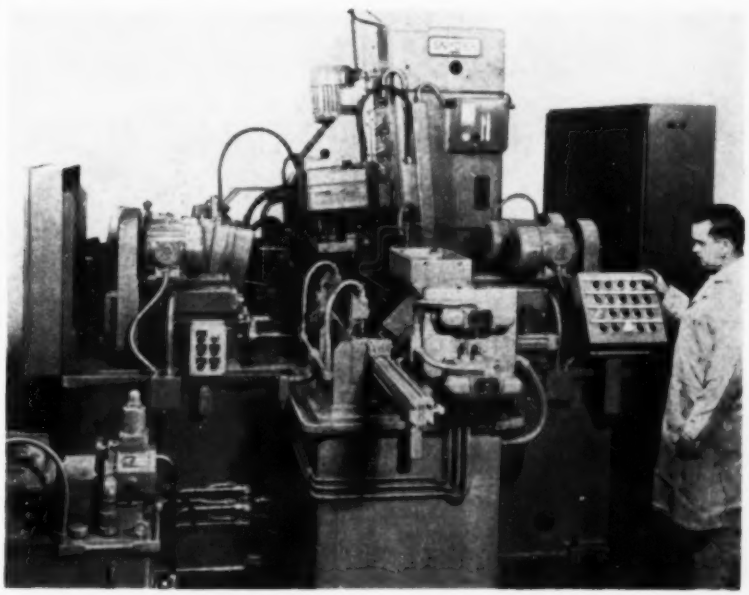
Hand-I-Hack's high speed blade cuts anything from 3 x 3-in. solid steel to thin wall tubing with a tolerance of 0.005 in. It can be used in any position, even upside down. Model weighs 48 lbs.

Unit's draw cut, lift return action is said to extend blade life up to ten times that of blades used in gravity type portables. Sawing action is fully adjustable from the pressure required for solid steel, bar stock, or angle irons, to the feather touch needed for thin wall tubing, rolled forms, or structural shapes. Equipped with automatic shutoff, it can be clamped on to work and will support itself.

Although sawing speed is determined by tooth spacing and capacity of blades to clear chips, the Hand-I-Hack cut through a 3 x 2-in. piece of cast iron in 9 minutes, 46 seconds in a recent test.

Lipe-Rollway Corp, Syracuse, NY

MORE DATA? Circle 91, inside back cover



TRUCK ENGINE ROCKER-ARM SHAFTS are drilled and probed at a rate of 211 parts per hour by this six-station in-line transfer machine. A rotating finger transfer bar advances the SAE 1010 tubular 17-in. long, ¾-in. OD rocker-arm shafts, from station to station—*Snyder Corp, 3400 E Lafayette , Detroit 7, Mich*

MORE DATA? Circle 92, inside back cover

30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18" Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6" in diameter, 3 16" face width, with 1/8" depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.

Tests were run on these three Jones & Shipman production grinders. Results showed that the new grit, Selected Natural Diamond (SND-RESINOID), increases the life span of natural diamond resinoid wheels by 30% to 50%.

INDUSTRIAL DISTRIBUTORS (SALES), LTD.

YOU CAN DEPEND ON NATURAL DIAMONDS

Herbert W. Westeren, Asst. Director of Hayes Research & Development Group, Reports . . .

PRODUCTION HEAT TREATING BREAKS THE 3000°F. BARRIER

Today's "exotic" refractory metals for nuclear reactors, rocket engines, and electronic components call for heat treating temperatures of 3000°F. plus . . . temperatures heretofore limited to the laboratory.

Vacuum is often the answer. In keeping with our leadership in the vacuum field, our group developed a high temperature, high vacuum furnace for sintering, annealing, and firing operations. This versatile modification of the well-received Hayes VacuMaster® features changes in valving, power requirements, and low voltage heating elements to extend temperatures into the 4500°F plus range. Scaled for full production, Model HT/HV affords advantages of rapid cycling, saturable reactor control, cold wall construction, and vacuum to 0.1 micron.

Atmosphere furnaces are needed, too. For processing with non-oxidizing atmospheres, our group also developed the M-Y Moly Element Furnace. Uses of this 3300°F unit: reducing tungsten and silicon, ceramic metallizing, and other ultra-high temp. work. Also in design is an oxidizing and reducing atmosphere electric furnace for the 3500°F range.

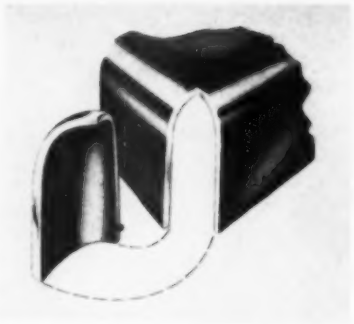
These new Hayes furnaces, developed under actual production conditions in our lab, are now serving industry on high temp. jobs perhaps similar to your own. Vacuum Furnace Bulletin 5709A and M-Y Furnace Bulletin 5805 give details. Write for copies.

C. I. HAYES, INC.

837 Wellington Avenue • Cranston 10, R. I.
Established 1905

ELECTRIC FURNACES

"It Pays To See Hayes" for metallurgical guidance, laboratory facilities, furnaces, atmosphere generators, gas and fluid dryers



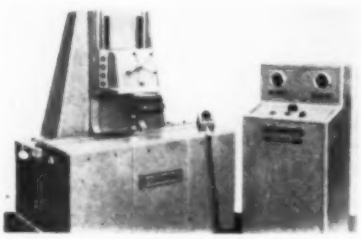
Spherical Corners With Tangent Flange Offered for Weldments

Prefabricated spherical corner with tangent flange is said to make possible economical production of ball-corner design weldments. Present V-dies do not have to be altered to fabricate a spherical-cornered design. After the four corners of the workpiece have been notched and bent, the prefabricated corner can be welded into place.

Available in mild steel, stainless steel, and aluminum, the corners have a stock size range of ½ to 1½-in. radius, from 10 to 18 gage. Flange length varies from 2 to 6 in.

Conner Steel Products, 24690 Telegraph Rd, Detroit 41, Mich

MORE DATA? Circle 93, inside back cover



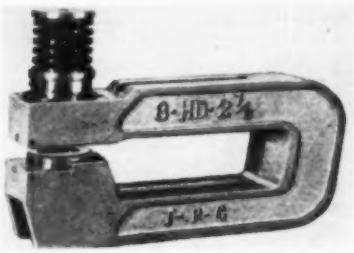
New Fatigue Tester Covers Load Range From 0.6 to 20 Tons

Universal Pulsator PUV vertical machine, added to Schenck line, is available in a series of four sizes that cover a load range of from 0.6 to 20 tons and a frequency range (load cycles) from 600 to 10,000 cpm.

Extremely large stroke enables units to test very soft materials (rubber or plastic) with low frequency, and rigid parts (gear wheels, steel test bars) with high frequency. It also extends application to torsion and bending tests that previously required special, single-purpose machines. Test frequency can be selected by means of an infinitely variable speed drive to expose the part as close as possible to actual operating conditions. Test frequency can also be set to maximum for fast results of S-N curve investigations. Automatic control device with differential relay maintains the originally adjusted pre-load and alternating load constant within ± 1 to ± 3%. It also shuts off the machine in case of excessive material deformation or fracture.

Imported by Cosa Corp, 405 Lexington Ave, New York 17, NY

MORE DATA? Circle 94, inside back cover



TPC Unitized Tooling Available In Standard Heavy-Duty Line

Series HD is designed for perforating various materials up to ¼-in. mild steel or its equivalent in tensile strength. Alloy steel holder of high tensile strength provides crush-proof die seats and permits introduction of the Skinhrd Guide Hole, introduced for the first time in TPC unitized tooling. Unit bottoms are guaranteed flat and square with the centerline of the punch, insuring accurate location of perforation in relation to the pilot pin for close, accurate templet-mounted application of units. Punch and die can be easily removed while unit is mounted in the setup.

Additional features include built-in lubrication, and additional stripping force through disk springs.

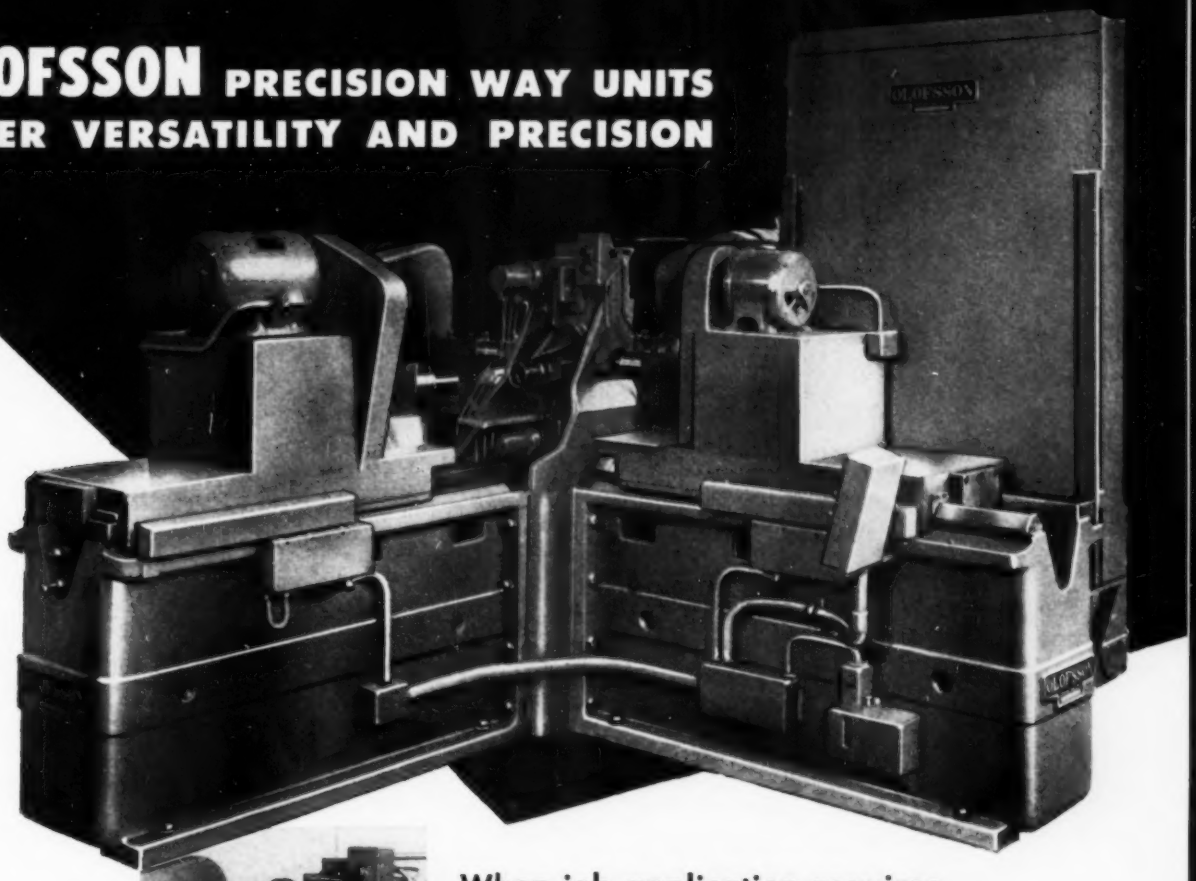
Tool Products Corp, North Tonawanda, NY

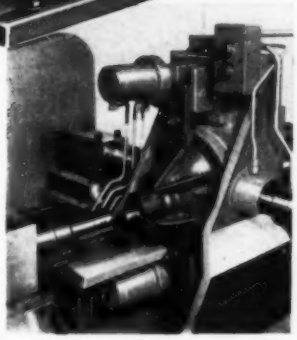
MORE DATA? Circle 95, inside back cover

SAFETY FEEDER TOOL, equipped with a magnet that lifts up to 10 lbs, can be operated with one hand. It is 14 in. long and costs $6.50—*Ullman Devices Corp, Ridgefield, Conn*

MORE DATA? Circle 96, inside back cover

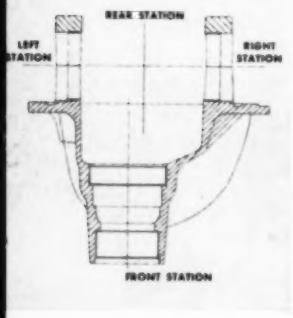
OLOFSSON PRECISION WAY UNITS OFFER VERSATILITY AND PRECISION





Differential carrier, hydraulically cam-clamped in position for simultaneous precision boring.

Cross-section of differential carrier illustrating various operations performed.



When job application requires versatility consider the use of Olofsson Way Type Precision Boring Units.

These Units can be arranged to meet your particular production requirements. Use one way unit . . . two units at either 90° or 180°, 3, 4 unit, or multilpe units. Units can be combined with a center fixture section to suit production requirements.

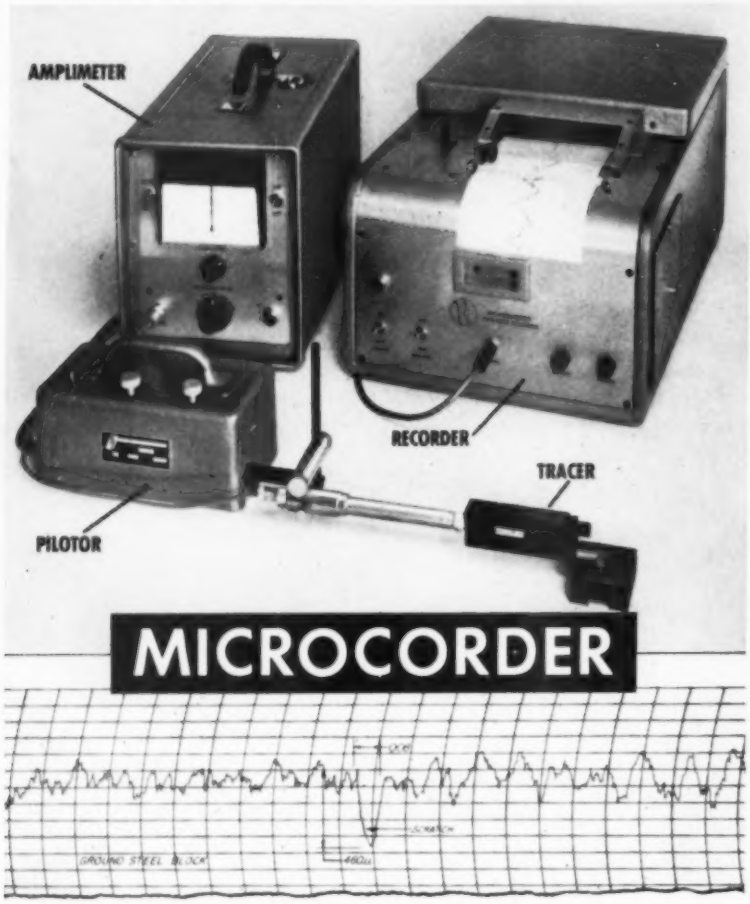
The 4-Way Machine illustrated above makes 4 precision bores simultaneously. Diameters are held to .0005" with the required 90° angles. When required, progressive operations can be performed on the part. Units are electrically interlocked, operate from a single push-button station.

For a demonstration on how Olofsson Way Units can suit your particular production requirements, call on your local Olofsson representative.

THE OLOFSSON CORPORATION
LYONS AVENUE • LANSING, MICHIGAN
Phone IU 46381

MACHINERY DIVISION

Presenting A NEW INSTRUMENT FOR SURFACE INSPECTION AND CONTROL



THE MICROCORDER draws a magnified roughness profile of ID, OD and flat surfaces, for any length of trace up to 2¾". From its 4"-wide chart you can readily measure the *peak-to-peak spacing* and *peak-to-valley height* of roughness irregularities — and the *width* and *depth* of pits, scratches, chatter marks and surface porosity. A wide range of magnifications is provided.

This instrument is as simple to use as a TV set, and is equally at home in shop, lab and inspection department. It is used on metals, paper, plastics, ceramics and many other materials; and it is made and guaranteed by the *pioneers* in surface-measurement instrumentation.

Detailed specifications are given in Bulletin LT138. May we send you a copy? Write —

MICROMETRICAL MANUFACTURING COMPANY
345 S. MAIN ST. ANN ARBOR 1, MICHIGAN

Manufacturer of the PROFILOMETER®, PROFICORDER®, MICROCORDER, WAVOMETER®, ANDEROMETER®, VAROMETER, CHART VIEWER • Exclusive American Sales Agent for CENSOR Dimensional Gaging and Sorting Equipment

FIELD REPORT...

M & M Enters Carbide Blade Field

Motch & Merryweather Machinery Co of Cleveland has bought Modern Tool Corp and Radial Cutter Manufacturing Corp of Elizabeth, NJ. Both companies make carbide tipped circular saw blades for a variety of applications including ferrous and nonferrous metals, plastics, and wood products. Plant facilities will be moved to Cleveland and made a part of the company's Cutting Tool Manufacturing Division which produces segmental and solid cutoff blades, slitting saws, and special tools. Distribution will be handled through M & M's present organization.

Bliss to Sell Toledo Plants

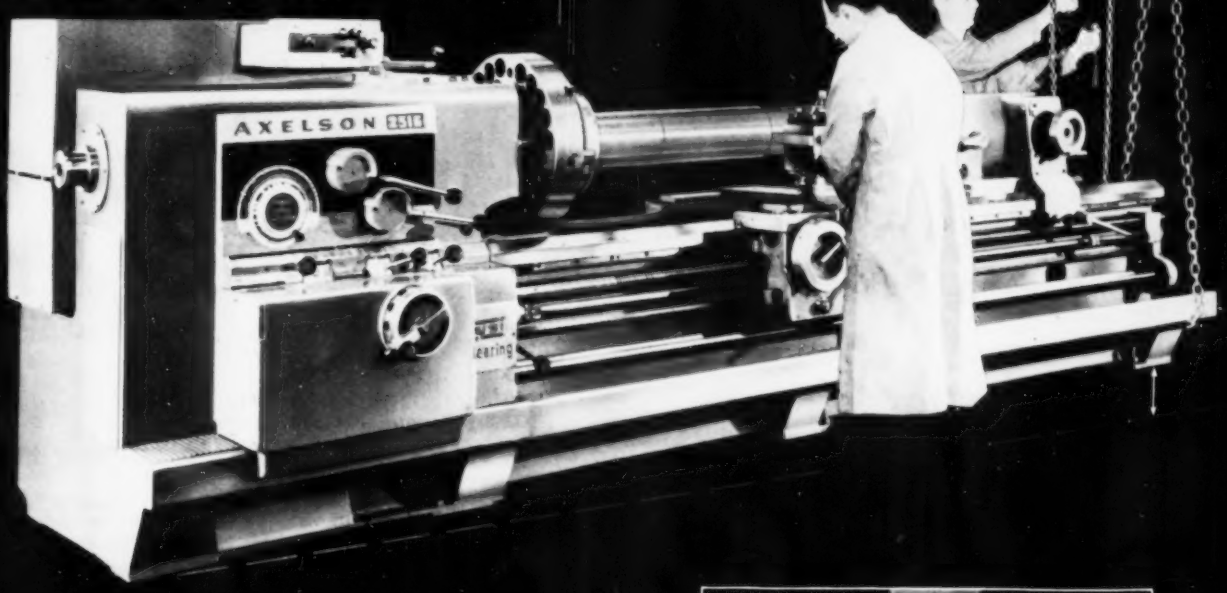
E W Bliss has decided to sell its inactive manufacturing facilities in Toledo. Formerly engaged in making metalworking presses, facilities include a 165,000 sq-ft Meehanite foundry capable of handling castings weighing up to 60 tons, and a 230,000 sq-ft heavy machine shop. Plants have been inactive for more than a year. Manufacture of machines formerly made at Toledo has been consolidated at the company's other plants. Service of Toledo-built presses will continue to be handled from the company's press building facilities at Canton, Ohio, and Hastings, Mich.

Ford Motor Co Licensed to Use US Rubber's Laminating Technique

US Rubber Co has licensed Ford to use its method for continuously laminating vinyl plastic sheet to metal. Ford is the first automotive

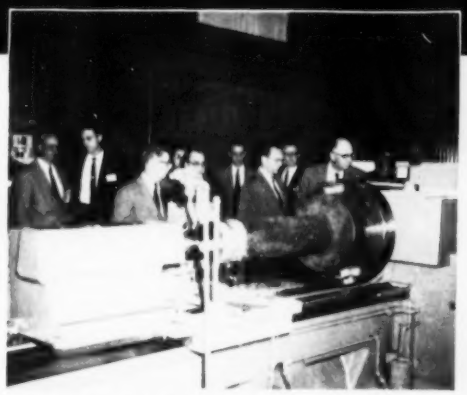
"Oh, what's the use . . ."

WHAT DOES THIS STARTLING TEST MADE ON THE NEW CLEARING-AXELSON LATHE MEAN TO YOU?



In a recent demonstration before editors of the metalworking press, Clearing repeatedly raised and lowered one end of the Blue Chip lathe with an overhead crane—while the lathe was running. Accuracy on the ¾" cut in progress was held within .002" across the full length of the workpiece.

Certainly, you aren't going to operate a lathe with one end hanging from a crane. The test we made with the new Blue Chip lathe simply demonstrates the enormous rigidity of its all-steel bed. Why such rigidity? Demands placed on lathes by ceramic and sintered carbide tooling necessitates extreme stiffness and rugged construction in order to hold tolerances on heavy, high-speed cuts.



Here's What This Rugged Construction Means To You

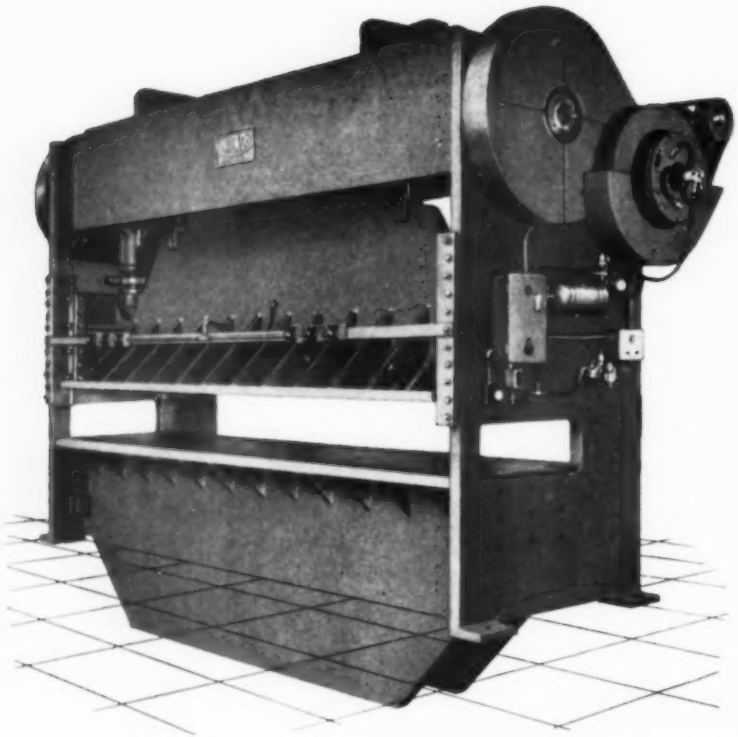
Greatly Improved Tool Life—Reduced Breakage. Production Potential Unheard of With Conventional Equipment. But there is more—much more—than just 18 times greater rigidity in the Blue Chip story: For all the facts write for the Clearing-Axelson Blue Chip Lathe catalog. We'll send it promptly. Clearing also distributes the Clearing-Harrison Lathe in sizes from 11" to 16".

Write for New Catalog on Blue Chip Lathe

USI **Clearing** DIVISION OF U. S. INDUSTRIES, INC. 6499 W. 65th Street • Chicago 38, Illinois

PLANTS IN: CHICAGO LOS ANGELES HAMILTON OHIO

CIRCLE 250 READER SERVICE CARD



CHICAGO DREIS & KRUMP **PRESSES**
STRAIGHT-SIDE TYPE

large die area
capacities up to 400 tons

This is a typical model of CHICAGO straight-side-type presses used for multiple punching, notching, and trimming operations. This press with a die area of 48 inches by 198 inches has a capacity of 200 tons.

Complete recommendations for any job on request.

6674

CHICAGO DREIS & KRUMP Press Brakes • Straight-Side-Type Presses • Press Brake Dies
Hand and Power Bending Brakes • Special Metal-Forming Machines

DREIS & KRUMP MANUFACTURING CO.
7434 South Loomis Boulevard, Chicago 36, Illinois

Field Report . . .

company to be licensed to use the technique, called the Marvibond process, developed in 1953 by the rubber firm's Naugatuck Chemical Division. It's also the first licensee of the process that makes both its own vinyl plastic film and steel. Ford is presently using vinyl-coated steel extensively in the 1959 Thunderbird interior and the extended use of vinyl-to-metal laminates in other model lines is currently under study.

Ex-Cell-O's 40th Birthyear

In 1919 a small group of Detroit toolmakers formed a company to produce parts to standards of precision that were beyond the capabilities of many plants at that time. Initial manufacture of small jigs and tools was followed by production of drill jig bushings and the development of precision grinding spindles. Company then started research in precision boring and introduced its first precision boring machine in 1930, marking Ex-Cell-O's entry into the machine tool field.

Next step was the acquisition of Continental Tool Works which produces metal cutting tools ranging from small form tools to huge broaches. In 1935 Ex-Cell-O took over an experimental machine developed by the American Paper Bottle Co of Toledo and the following year put it on the market as the Pure-Pak that packages milk and other diary products in paper containers. During the 1930's the company's Machinery Division branched out from the precision boring field and introduced precision thread grinders, way-type bor-

(continued on p161)

"Success hasn't changed him any—he's still the same S. O. B.!"

SHORT TOOL LIFE due to chip weld, cratering and burning, in many cases, has been traced directly to lube oil dilution of cutting oil effectiveness. Cleartex can end this problem forever.

Diluted cutting oil shortens tool life drastically

Lubricating oil is probably leaking into the cutting oil sumps of your automatic screw machines as you read this. Current research proves that this is happening in 70% of all the automatics in use today! And where it happens, it shortens tool life by as much as 50%—even 70%. On top of this, the cost of extra regrinds, lost production during tool changes, and excessive scrap production is putting a premium on screw machine operation in too many shops.

Look for these symptoms. One sure sign of dilution is the need for frequent refilling of the lube oil sump. If you are using an ordinary lube oil, this dilution will create two additional—and more costly—symptoms: excessive scrap production and frequent regrinds. Now you can eliminate these forever with the

TEXACO CLEARTEX CURE

The exceptional chemical stability and load-carrying ability of Texaco's Cleartex series make them equally suitable for use as cutting oils, lubricants or hydraulic fluids. All you have to do is use them for both cutting *and* lubrication. With Cleartex in *all* your sumps, you'll find cutting oil dilution will stop and screw machine production cost will drop substantially.

Write today for your copy of Texaco's helpful new booklet "Cleartex in Automatic Screw Machines"...and contact your local Texaco Lubrication Engineer for an authoritative survey of your automatics. Just call the nearest of the more than 2,000 Texaco Distributing Plants, or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y., Dept. AM-22.

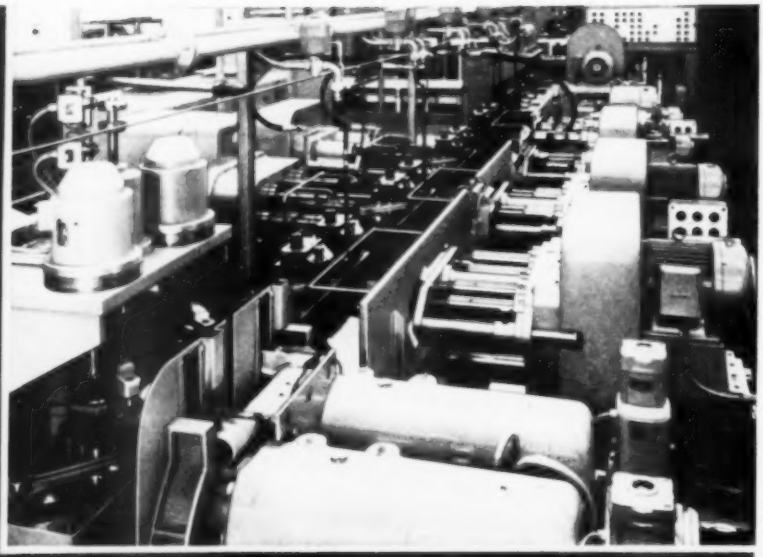
CONSTANT PROGRESS IN OILS FIRST CENTURY

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

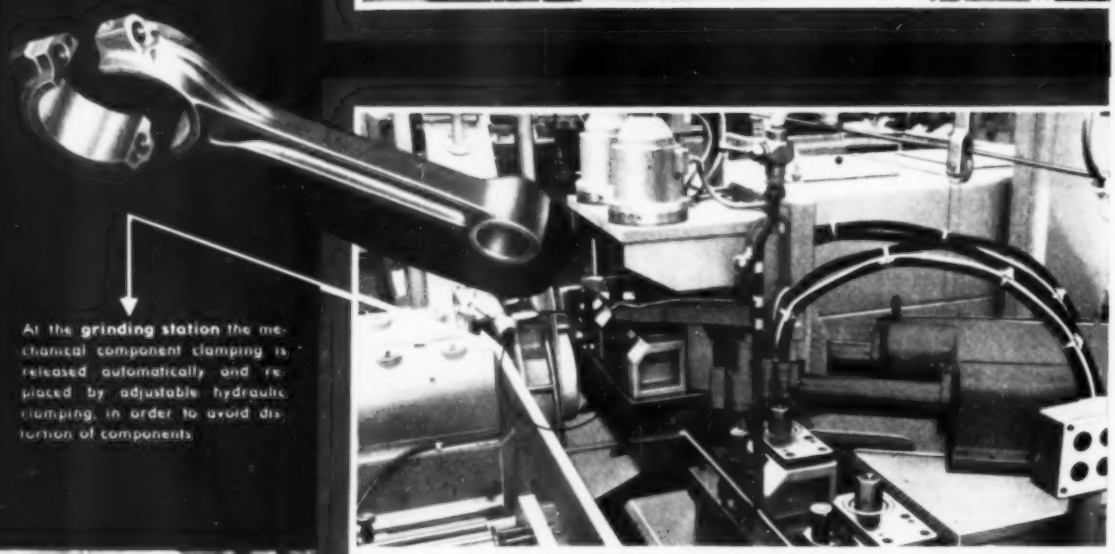
(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

HEINEKEN

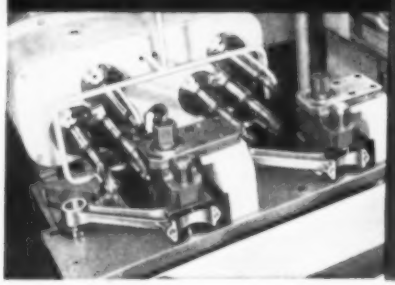
TRANSFER LINES



for boring, spotfacing, chamfering and reaming of fixing and locating bores, as well as fine milling and grinding parting off faces or connecting rods and covers



At the **grinding station** the mechanical component clamping is released automatically and replaced by adjustable hydraulic clamping, in order to avoid distortion of components



LUDWIGSBURGER MASCHINENBAU GMBH
LUDWIGSBURG/WURTT./GERMANY

ing machines, and special machinery of many types. Jet blade profiling machines and vertical boring and contouring machines were brought out immediately following World War II.

Today the company has 29 plants throughout the US, Canada, England, Germany, and India. From an original floor area of 2375 sq ft forty years ago, combined capacity of all of the company's plants today totals over 2.5 million sq ft. Excellent, Ex-Cell-O.

Du Pont's Delrin

Du Pont Co will commercially launch its first new major plastic in ten years when Delrin gets into full production late this summer at a new plant in Parkersburg, W Va. Made from a formaldehyde base, the material is 80% lighter than aluminum but, according to the company, is the first plastic with strength approaching that of non-ferrous metals. Company claims use of the plastic could save auto producers $45 million over the next five years. Applications include such items as steering column housings, exterior trim, door handles, locks, and hood releases.

Westinghouse to Spend $25 Million on Expansions

Westinghouse Electric Corp will expend more than $25 million on expansion of facilities to boost production of electric power apparatus. Some $21 million will go toward modernization, rearrangements, and additional facilities at the Lester, Penna, steam division plant; $3 million will be spent at the East Pittsburgh unit to increase output of

"Someone to see you, Sir . . . a personal matter I imagine."

POSITIVE FILTRATION

(TO 1/2 MICRON) FOR AS LITTLE AS

.00015¢ PER GALLON!

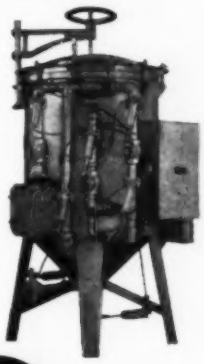
AND IT'S COMPLETELY AUTOMATIC!

Now, from Olson, a new dimension in industrial filtration — the first completely automatic, pressure-type filter! Every cycle — precoat, run, backwash—is automatically controlled. Injection of filter-aid (when used) and sludge carry-out are also automatic.

Maintenance is virtually eliminated in this trouble-free system. No parts to change, no elements to replace, and most important, *no costly downtime for cleaning!*

In large central systems, or with individual machines, Olson Filters guarantee over 96% purification of all types of coolants, cutting oils, quenching oils, cleaning and washing solutions and other industrial solvents at the lowest cost per gallon.

By the way, what are *your* costs per gallon? Why not check and see? Then call Olson.

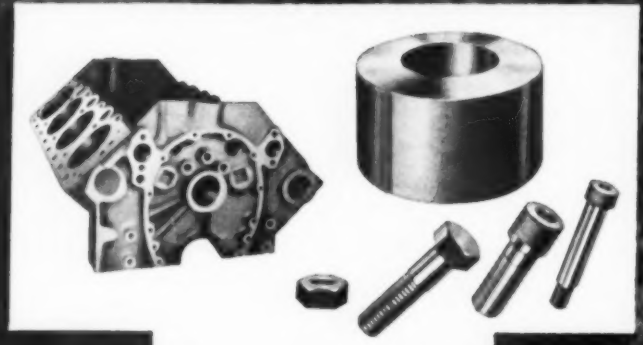


The new Olson Industrial Filter is available in 8 standard models, from 10 gpm to 600 gpm capacities.

Write for free catalog on the new Olson automatic pressure-type filter.

OLSON FILTRATION ENGINEERS
Division of The American Laundry Machinery Company
DEPT. M, CINCINNATI 12, OHIO

VALVOLINE
Tectyl
protects metals
against RUST



VALVOLINE'S amazing Tectyl rust preventives protect metal surfaces against *every kind of rust and corrosion* during storage and shipping.

Low-cost Tectyl compounds are easy to apply by brush, spray or dip and just as easy to remove. They protect metal surfaces against . . . sun and rain . . . heat and cold . . . salt air and salt water . . . humidity, perspiration and corrosive fumes.

Tectyl rust preventives meet exacting government specifications.

Write today for these two helpful Tectyl charts

1. "Valvoline Tectyl U. S. Government Approved Packaging and Preservative Chart." Gives the Army, Navy and Air Force "Specs" and applications.

2. "Valvoline Tectyl Industrial Rust Preventive Comparison Chart." Specifies applications covering the entire field.

VALVOLINE
Tectyl
ALL-METAL PROTECTION
RUST PREVENTIVES

VALVOLINE OIL COMPANY, Freedom, Pennsylvania
A Division of Ashland Oil & Refining Co.

Field Report . . .

generators and large motors; $1 million will boost production of steam turbines at the Sunnyvale, Calif, facilities.

Expansion at Lester will increase production capacity of steam turbines, heat transfer equipment, and related products by approximately one-third. Most of the money allocated will be used for purchase of new machine tools and rearrangement of equipment to improve efficiency of the manufacturing cycle. Employment after completion of the two-year program is expected to reach the 9000 figure; current employment is 7500.

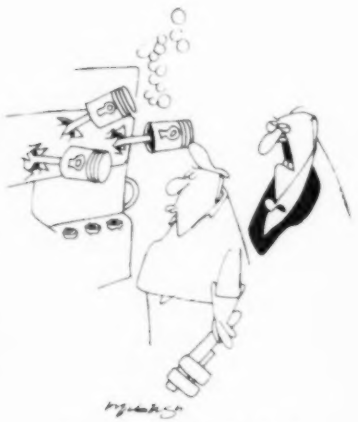
O S Walker Acquires Buck

Buck Mfg Co, San Jose, Calif, has been taken over by O S Walker Co, Worcester, Mass, designer and manufacturer of magnetic chucks. Buck designs and makes Bux portable magnetic drillpresses and related products.

Avco Gets $13 Million Engine Order

Avco Corp's Lycoming Division in Stratford, Conn, has three AF contracts for gas turbine engines. New awards bring the total dollar value of contracts received by the Division during the past month to $44 million. One of the new orders is for development of a higher rated version of the T-53 engine, upping shaft hp from 860 to 960.

Company's Nashville Division has a subcontract from Lockheed's Georgia Division to make large-size panels of Avcomb stainless steel honeycomb to be used in the sections of fuselage of the B-70 Valky-



"You guess you forgot to oil it?"

remove up to 25% more metal every stroke with the "Magicut" All-Purpose file

If you're filing metals with a file that isn't called "Magicut" and doesn't have a Nicholson or Black Diamond trademark, please read on.

By changing to this file, you can cut metal filing costs as much as 25% compared to the next most efficient file for the same metal. The extra efficiency comes from the unique tooth pattern. The "Magicut's" teeth are on an extreme angle. They're termed "penetrating-planer" type teeth. As the name suggests, each stroke takes a deep bite and leaves a smooth surface.

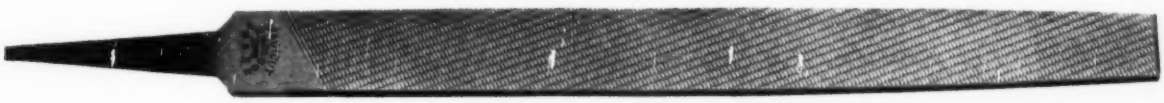
To get faster results at lower costs, change from conventional machinists' files to the "Magicut." Use it on magnesium, copper, carbon steel and most other industrial metals. We believe you will see dramatic results. Ask your Nicholson or Black Diamond file distributor for a demonstration and try it yourself.

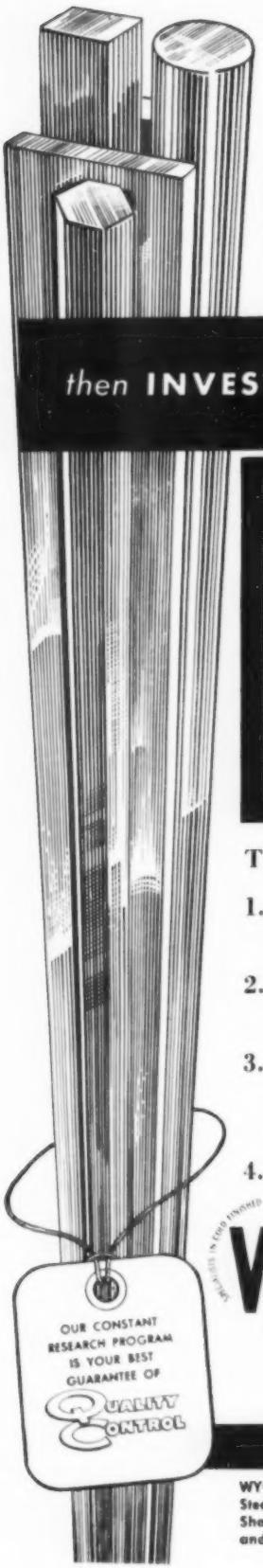
NICHOLSON U.S.A. NICHOLSON BLACK DIAMOND U.S.A.

NICHOLSON FILE COMPANY, PROVIDENCE 1, R.I.

Files • Rotary Burs • Hacksaw and Band Saw Blades
Ground Flat Stock • Industrial Hammers

* Industrial Distributors provide the finest goods and services in the least possible time. Our products are sold exclusively through them.





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Positive Uniformity
in your **COLD FINISHED STEELS?**

then **INVESTIGATE**

WYCKOFF
CARBON CORRECTED
STEELS

THEY PROVIDE:

1. **Predetermined and uniform microstructure**
2. **Excellent machinability for the grade**
3. **Can be induction hardened to full hardness without metal removal**
4. **Optimum fatigue resistance**

OUR CONSTANT RESEARCH PROGRAM IS YOUR BEST GUARANTEE OF QUALITY CONTROL

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Works: Ambridge, Pa.
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WYCKOFF STEEL PRODUCTS • Carbon, Alloy and Leaded Steels • Turned and Polished Shafting • Turned and Ground Shafting • Large Squares • Wide Flats up to 12¾" x 2¼" and 14" x 1¼" • All types of Furnace Treated Steels including Carbon Corrected Steels

Field Report . . .

rie 2000 mph bomber that Lockheed is producing for North American Aviation. Panels will be made in a new brazing furnace now being installed which will be in operation late this month.

North American Aviation's . . .

. . . Rocketdyne Division is moving into the solid propellant field with the acquisition of Phillips Petroleum Co's interest in Astrodyne, Inc, McGregor, Texas. Details are still being worked out, but it's understood that the arrangement calls for NAA, which has had 50% control of Astrodyne since Feb 1958, to become sole owners of the facility which specializes in research, development, and manufacture of high energy solid fuels, propellants, and devices.

Calumet & Hecla is Discussing . . .

. . . transfer of stock of Flexonics Corp, Maywood, Ill, to C&H. If transfer is effected, Flexonics will be operated as a subsidiary of Calumet, Chicago fabricator of non-ferrous metal tube and parts. Flexonics makes flexible metal and synthetic hose products.

US Chemical Milling Corp . . .

. . . Manhattan Beach, Calif, has taken over Darco Industries, Inc, missile component manufacturer with plants in El Segundo and Glendale. Darco's Flotrusion Division owns a proprietary process for cold-flowing metals into tubular forms.

United Aircraft Will Spend . . .

. . . $68 million for expansion and modernization of production and experimental facilities during 1959 and 1960. Major share of the expenditure

"Leave my tools alone Hasse; you don't see me taking your tools!"

"Since Cities Service Pacemaker 300 T-Injection molders operating perfectly."

Daniel A. Goetz, President and Charles R. Goetz, Dan's twin brother and Vice President of Stylette Plastics, agree on the value of a superior hydraulic oil. As Dan Goetz says, "we produce millions of 'giveaway' items every year. These items must be inexpensive . . . and to obtain the lowest cost possible we must produce in quantity and without expensive down-time on our injection molding machines. We had previously had trouble with our hydraulic oil and I think it was primarily due to the heat involved. We called in the Cities Service Lubrication Engineer and he switched us to Pacemaker 300 T. **Since using Pacemaker 300 T, our six injection molders have been operating perfectly."**

Pacemaker T is a premium hydraulic oil with excellent heat resistant properties and suitable for every type of hydraulic system. These oils have high viscosity index to minimize viscosity change with changing temperatures.

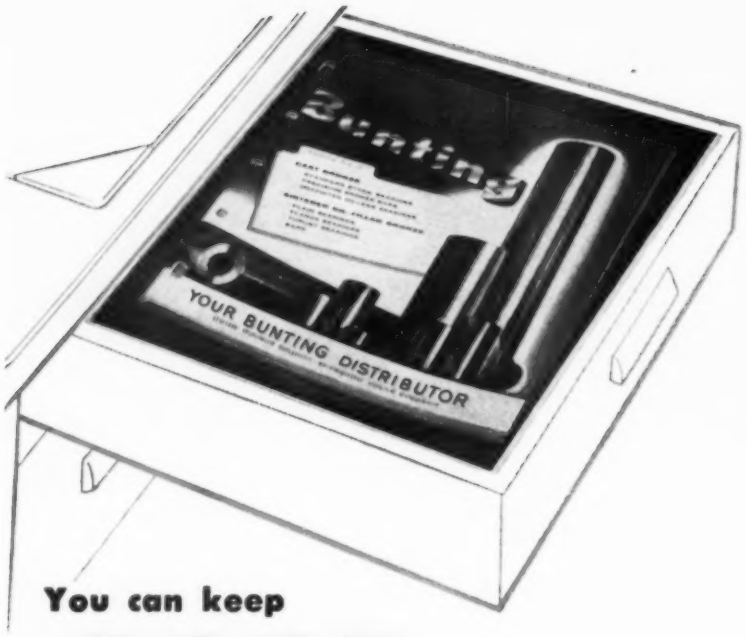
They are also fortified to resist oxidation and to give maximum protection against corrosion and rusting.

Contact your nearby Cities Service office for an experienced Lubrication Engineer to show you what advantages Pacemaker T can offer in your operation . . . or for further information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

The Goetz Twins, owners of Stylette Plastics went into the plastics business in Pittsburgh in 1952 on the recommendation of their professor at Duquesne University. They started with $1,500 and bought a nine ounce injection molding machine to make plastic tile.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



You can keep

2365

BEARINGS AND BARS IN YOUR DESK DRAWER

Let your local Bunting Distributor carry your bearings inventory. Hundreds of Bunting Distributors and Eleven Bunting Branches supply from stock the most advanced, highest quality bearings, completely machined and finished, at low cost anywhere in America.

. . . where to get them

Your Bunting distributor is listed in the classified section of your telephone directory usually under Bars — Bronze, and Bearings — Bronze. Two Bunting factories and eleven Bunting Branch Warehouses expedite distribution in all areas. Ask your local Bunting distributor or write for catalogs.

. . . made to blueprint

Bunting offers unmatched engineering and manufacturing facilities for special bearings and parts of Cast Bronze and Sintered Oil-filled Metals.

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CATALOG NO. 58 listing...866 sizes of Bunting Cast Bronze Standard Stock Bearings.

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Field Report . . .

will be in the corporation's Connecticut plants. R&D facilities will get $39 million, production facilities, $29 million. All four operating divisions of United—Pratt & Whitney Aircraft, Hamilton Standard, Sikorsky Aircraft, and Norden—are included in the program as well as United's research department in East Hartford, and United Research Corp of Menlo Park, a Calif subsidiary.

$15 Million Railroad Car Order

Pullman-Standard's Bessemer, Ala, plant is building 750 composite aluminum-steel gondolas for Southern Railway. Cars will have aluminum bodies and undercarriages of steel. This is the first time the Bessemer plant has used aluminum in its cars and, as a result of the order, will install aluminum welding equipment. Deliveries will start in October and will run through mid-December.

Southern has also ordered 490 additional cars, to cost $10.3 million, from Magor Car Corp, Passaic, NJ.

Link-Belt Acquisition

Link-Belt Co has bought the patents and assets of the Teco continuous automatic metal chip handling system from the Turbine Equipment Co, Westfield, NJ. System, which will complement L-B's present line of conveying and processing equipment, upgrades chips and turnings by crushing them to a uniform size and extracting oil or coolants which may be purified for re-use.

"In your new position, Benson, you will have much greater responsibility, much more work, much more authority and slightly higher pay."

·Greater Accuracy
·Less Downtime
·Lower Costs!

NEW
BESLY
DH4 Double Horizontal Spindle Disc Grinder

This new grinder is built for top accuracy plus substantial economy. The exclusive Besly precision quill and clutch infeed provides for feed increments calibrated in millionths. Abrasive discs can be changed in 30 minutes without disturbing setup (a 200% saving in downtime over conventional disc grinders)! Dressing time is cut to four minutes (a 500% saving)! Coolant is always under control and the cooling system is insulated from the grinder. Get full facts today . . . convince yourself that the Besly DH4 will help you do better work at lower cost.

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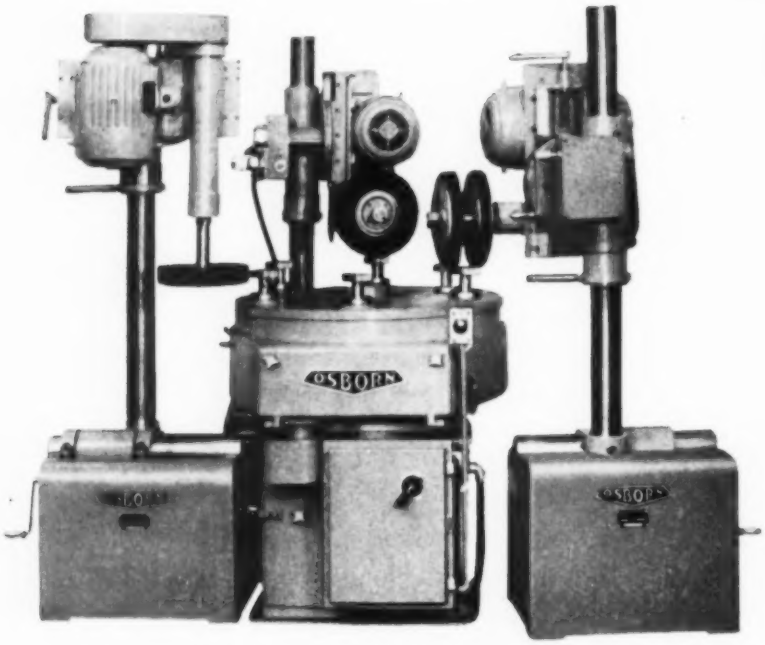
Cut your metal finishing costs with this...

NEW OSBORN BRUSHAMATIC® ROTARY INDEX MACHINE



NEW OSBORN BRUSHAMATIC® ROTARY INDEX MACHINE
Units can range from manual to fully automatic operation

Unique "building block" design means unlimited production flexibility

NEWEST ADDITION to Osborn's broad line of metal finishing machines are these Brushamatic® Rotary Index units. Capability: significant increase of your production capacity.

Most important feature—production men can economically "build" *custom* Brushamatic Machines from *basic "building block"* components . . . brushing heads, index tables and electric controls. Other advanced design and construction features make these new Brushamatic units worth your immediate investigation.

Your Osborn field specialist has latest application data on a wide range of cost-saving finishing methods. And an **O**sborn **B**rushing **A**nalysis—made in your plant—is the first step to pinpoint savings on *your* operations. Write for details. *The Osborn Manufacturing Company, Dept. C-87, Cleveland 14, Ohio.*

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POWER, PAINT AND MAINTENANCE BRUSHES
FOUNDRY PRODUCTION MACHINERY

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Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

MACHINES AND ATTACHMENTS

1 TURRET DRILLING MACHINES —*Brown & Sharpe Turret Drilling Division, Inc, 20 Fitch St, East Norwalk, Conn.* 21-page catalog IT describes and illustrates design and construction features of machines and work-positioning tables. Discusses B&S technique which utilizes a machine on which six spindles work on a single axis so that tools for drilling, tapping, boring, or reaming can be indexed in any sequence and locked into alignment with main drive spindle. Machines covered include Model A which has a ½-in. drilling and tapping capacity in steel with a 22 x 24-in. table work surface, and Model B and Model B Automatic with 1-in. capacity in free machining steel and 28 x 32-in. surface.

2 THREADING LATHES — *Gisholt Machine Co, 1245 E Washington Ave, Madison 10, Wis.* 8-page illustrated bulletin 1215 gives details on Cri-Dan Model B high-speed, semi-automatic, single point lathe. All types of threads can be generated including single or multiple start, coarse or fine, left or right hand, straight or tapered, and either internal or external. Unskilled labor can be used to load, start threading cycle, and unload the work; standard machine can be set up in 15 minutes or less on most jobs.

3 END MEASURE JIG BORERS—*Pratt & Whitney Co, Charter Oak Blvd, West Hartford, Conn.* 28-page circular 614 presents illustrated description of construction features and specifications for three models for every work size requirement. Open side design makes it possible to machine larger work sizes and a greater variety of shapes than on jig borers of any other type. End measure system detailed. Additional equipment pictured and described.

4 20-IN. BANDSAW—*Rockwell Manufacturing Co, Delta Power Tool Division, 462 N Lexington Ave, Pittsburgh 8, Penna.* 8-page illustrated bulletin describes unit with a variable speed drive (50 to 4500 fpm) for cutting everything from stainless to aluminum, wood, and plastics. Includes specifications, catalog listings, motors and motor controls for single-phase and three-phase operation, and list of accessories.

5 NUMERICAL CONTROL SYSTEMS —*General Electric Co, Schenectady 5, NY.* 8-page publication GER-1581 explains how systems for machine tools completely direct automatic production of simple and complex parts in job-lot production. Numerical positioning control

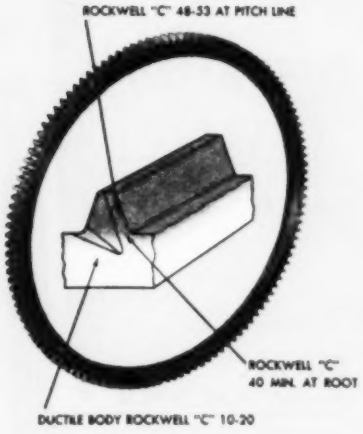
"I'm not interested in why you're 10 minutes late today; where were you Monday and Tuesday?"

To the Outboard Motor Industry

on its

GOLDEN JUBILEE

At the end of its first half century the outdoor motor industry can regard its "family of fans" with pride—all 35,000,000 of them. Today almost 25% of this nation's population find fun, recreation, even employment in outboard powered craft.


ROCKWELL "C" 48-53 AT PITCH LINE
ROCKWELL "C" 40 MIN. AT ROOT
DUCTILE BODY ROCKWELL "C" 10-20
SHADED AREA IS HARDENED WORKING SURFACE

DOUBLE DIAMOND'S CONTRIBUTION

Major makers of electric-starting outboards come to Automotive Gear for their flywheel starter gear requirements. They receive our extensive experience in making millions of them for the automotive field—plus skilled engineering aid—plus respect for their specifications—plus localized hardening for better, longer gear performance—plus good delivery.

If you are powering a product, why not talk to the company that specializes in power transmission via gears of many types? An engineer will respond to your inquiry.

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Need Pressure AND Volume?

Replace with GRAYMILLS *Superflo* COOLANT PUMPS at less cost!

For such operations as:

- Instant flow thru check valves and restricted passages.
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Compact, dependable GRAYMILLS Coolant Pumps can give you up to 10 GPM at 65 ft. head. No metal to metal contact, no seals, no packing. Smooth, quiet performance. ¾ to 2 H.P. Sold by leading Industrial Distributors everywhere. Ask for Bulletin No. 30-10.

WRITE FOR THIS NEW CATALOG

Showing standard and JIC model centrifugal and gear type pumps, pumping units, accessories and helpful selection charts

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CHICAGO 13. ILLINOIS

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and numerical contouring control systems discussed; operation and application of both illustrated and described; case studies included.

TOOLS AND ACCESSORIES

6 "THE SPIRAL POINT—A NEW ERA IN DRILLING"—*Cincinnati Lathe & Tool Co, Cincinnati 9, Ohio.* 24-page booklet SP-165 describes new spiral point geometry for converting standard twist drills into precision tools. Illustrates cost-reducing advantages obtained; shows operation of the Spiropoint drill sharpening machine which permits the new geometry to be quickly and accurately produced in the shop.

7 CAM - OPERATED INDEXING UNITS—*Standard Tool & Manufacturing Co, 237 Laurel Ave, Kearny, N.J.* 26-page bulletin covers three models. In addition to drawings of the units, tabular data is included on indexing positions and cams, results of accuracy tests, and dimensions of standard tooling and dial plates; tables of load rating; and production per hour.

8 NEW INTERNATIONAL INCH — *Pratt & Whitney Co, Charter Oak Blvd, West Hartford 1, Conn.* 7-page circular 629 explains practical aspects of changeover. A questions-and-answers section covers the more immediate points that will concern most manufacturers. Includes a chart that can be used to determine whether or not the difference between the old and new inches will be significant for a particular job of specific dimensions and tolerances, and a chart by which measurements made in US Inches can be converted to International Inches.

9 CUTTERS — *Metal Carbides Corp, Youngstown, Ohio.* 68-page catalog 59-G covers complete product line including brazed tools and tips, Klamp-Lok toolholders, throw-away blanks, centerless blades, rolling mill rolls, heavy metal and technical data regarding proper application of Talide metal to cutting, drawing, and wear-resistant applications.

10 RECESSING TOOLS—*Maxwell Industries, Inc, 493 East 5th Ave, Ashtabula, Ohio.* Guide in the form of a sketch pad aids in specifying recessing tools by enabling the buyer to diagram and explain the machining operations he wants done by the tool. Check list to be filled out

"There! We got it all back together again."

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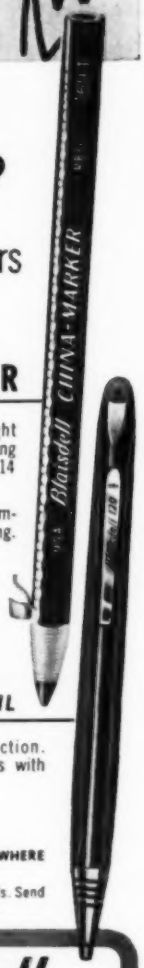
CHINA-MARKER

Unsurpassed for bold, bright marking on all surfaces. Strong and durable—adheres firmly—14 vivid colors.

OMNIMARK—Thinner diameter lead for fine line marking.



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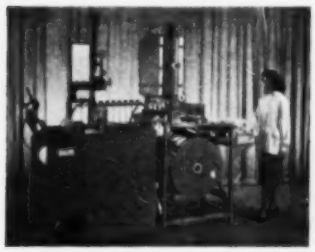
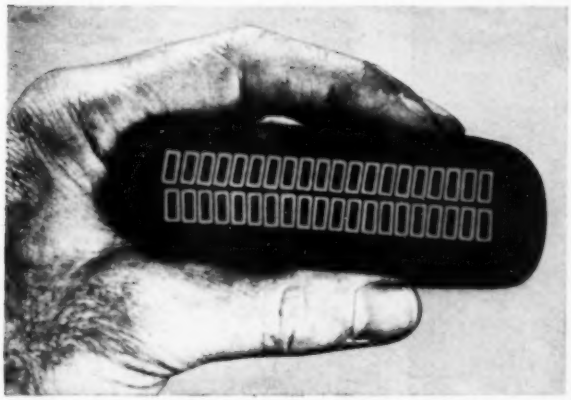
BETHAYRES, PA.

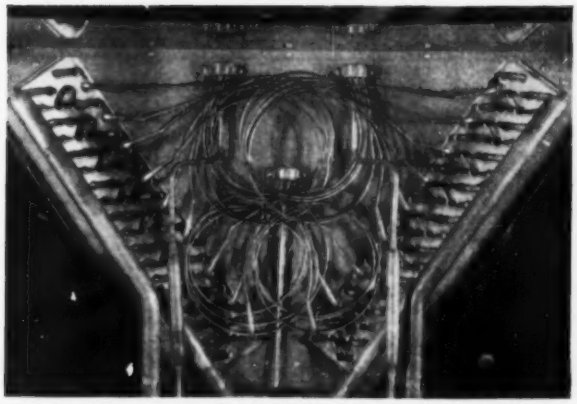
BETTER WAYS of doing things with seamless copper tube are unlimited—from capillary sizes to 26-inch diameter—round tubes or special shapes.

A better product faster. In the Kodak Roll Paper Dryer-Glazer shown below, photographic print paper travels around a heated, mirror-smooth, chromium-plated copper drum. This drum could be formed from sheet metal, welded and ground. But Eastman Kodak Company takes a production short cut and buys the drums ready made—Anaconda seamless copper tube 26" inside diameter, in wall thicknesses of ⅛", cut to 20" lengths. Having the thermal conductivity and corrosion resistance needed, the tube is also easy to polish to a high mirrorlike finish (photo, left), provides an excellent base for fine chromium plating. No seams mar the surface. Production time and steps are cut.





Rectangular copper tube carries current and coolant. By liquid cooling conductors in generator stator bars, General Electric has opened the way to doubling generator ratings without appreciably increasing frame size. Tubes, approximately 0.300" x 0.130" O.D., shown in cross section above, are shipped in long coils. Special-shape tubes are available in a wide variety of sizes, cross sections, and alloys.



High-precision tubes meter fluids. York Corp., subsidiary of Borg-Warner, has found restrictor-tube metering of refrigerant in packaged air-conditioning units up to 25-ton capacity has greatly reduced field service, made possible the 5-year protection plan on all units. Anaconda Copper Restrictor Tubes have consistently met York's strict requirements. These tubes are available in copper or aluminum in nominal I. D.'s from .025" to .090".

WHETHER you need long lengths of copper capillary tubing for air, hydraulic, or lubricating lines or for instrument tubing—or large-diameter tube in copper or a copper alloy, call your American Brass Company representative. He can help you select the product you need from the broadest range of seamless tubes available to industry. Or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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SEAMLESS COPPER TUBE

CAPILLARY TUBE • SPECIAL SHAPED TUBE

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AUTOMATIC POSITIONING

with the

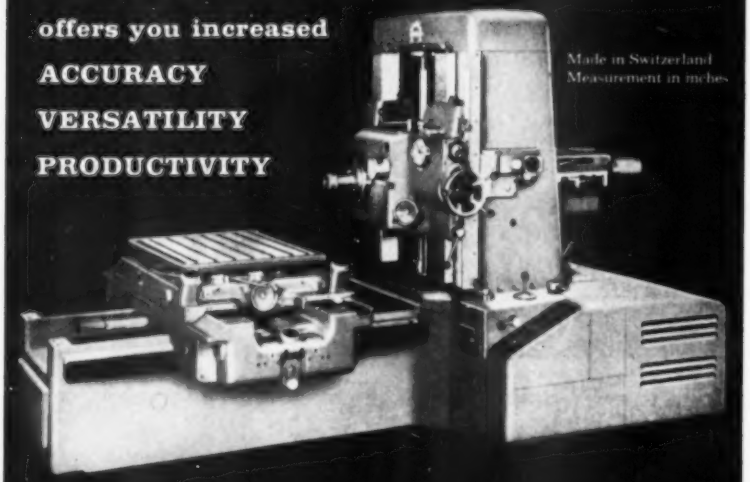
DIXI 75 horizontal optical jig borer

offers you increased

ACCURACY

VERSATILITY

PRODUCTIVITY



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Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting — direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
- Simplified controls functionally arranged for greater operating speed and efficiency
- 3" diameter boring spindle
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- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York.—Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

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covers machine used, kind of material, hardness, feed, speed, manual or automatic, spindle hole size.

11 ADJUSTABLE SNAP TORQUE WRENCHES—*Skidmore Engineering Co, 5130 Richmond Rd, Bedford Heights, Ohio.* Catalog sheet illustrates and describes new line. Design features, operating and application information included.

12 TRACER TURNING TOOLS—*Wesson Co, 1220 Woodward Heights Blvd, Ferndale 20, Mich.* 4-page illustrated bulletin 459 provides information on standardized line of Multicut tools that use standard 55° diamond-shaped throw-away carbide inserts. Applications for various styles pictured; dimensions and tolerances included.

13 CONVERSION FACTORS WALL CHART—*Precision Equipment Co, 4411 E Ravenswood Ave, Chicago 40, Ill.* Chart includes common conversions such as inches to centimeters, watts to hp, cu ft to liters, as well as less easily located conversions—microns to meters, quintal to lbs.

14 SNAGGING WHEELS — *Simonds Abrasive Co, Tacony & Fraley Sts, Philadelphia 37, Penna.* 4-page bulletin ESA-304 pictures and describes regular resinoid and vitrified bonded abrasive units for portable grinding machines. Sizes, shapes, and standard grain and grade specifications given for straight wheels, cup wheels, and abrasive cones.

● DRAFTING EQUIPMENT—*Mayline Co, 619 A Commerce St, Sheboygan, Wis.* Illustrated catalog 10 describes complete line of drafting tables; straightedges, both plain and parallel ruling. Request direct on company letterhead.

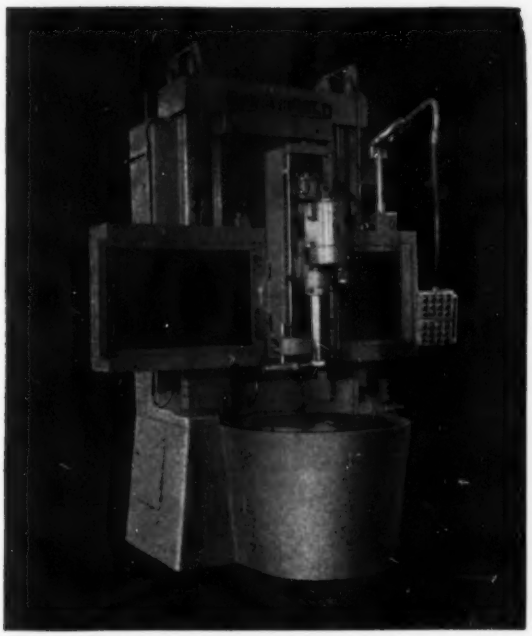
HEAT TREATING AND WELDING

15 RESISTANCE SOLDERING UNIT — *Zephyr Manufacturing Co, 201 Hindry Ave, Inglewood, Calif.* 4-page catalog K-3 contains information on three models of MicroBrazer units for assembly line soldering, and ten types of soldering probes. Development of precision soldering technique through use of electronically timed MicroBrazer is explained and illus-

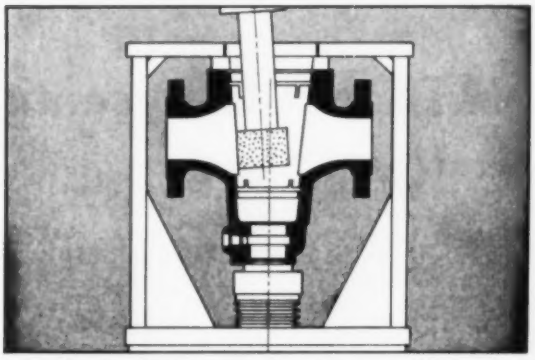
"That machine has automatic position control, positive clamping, adjustable spindle speeds, variable power feed, and the first thing you turn out on it is a reject!"

Vertical grinding tapers profitably

SPRINGFIELD



Standard vertical grinder above is typical of those used by leading manufacturers of large valves for grinding internal taper seats. Profits are made because set up time is fast; for example, it takes about five minutes to change over from grinding 18" valves to 10" valves. The inherent rigidity of the machine is made doubly effective by gravity. Valve, fixture, and face plate are supported on a heavy *vertical* work spindle which promotes accuracy, precise concentricity, and extremely fine micro-inch finish.



Internal valve tapers, as shown above, are fast payoff jobs on a Springfield Vertical Universal Grinder. On this valve taper, stock removal is 0.020" with a requirement for 85% blue or better on a taper gage. Surface finish is held well within the 30 RMS specified. Machine swings to 52", grinding holes from 2" to 42" dia., 24" deep in irregular or regular shaped work pieces.

Not limited to internal or exterior tapers, a Springfield grinds efficiently on O.D. and I.D. shoulders, offsets, undercuts, irregular holes, and mating angles—usually in one chucking.

A few production and toolroom men turn to a Springfield because there's no other way to do the job. Most turn to a Springfield because it's the most profitable way to do many jobs. Write today for Bulletin No. 197-D. The Springfield Machine Tool Company, Springfield, O.

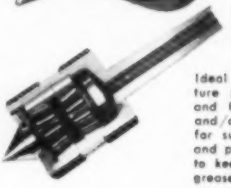
CIRCLE 267 READER SERVICE CARD

IDEAL GOLD BAND

LIVE CENTERS

GUARANTEED TO MATCH OR EXCEED, "CRITICAL" JOB SPECIFICATIONS

In the GOLD BAND line Ideal has combined the latest production methods with their traditionally fine craftsmanship to bring you an unequalled standard of excellence in live centers. Accurate, (to ± .0001") GOLD BAND Live Centers offer "custom" quality at production prices. Specify GOLD BAND Live Centers and your every need can be accommodated from stock . . . 99 times out of 100. Ideal's GOLD BAND Live Centers offer savings, simplified operations and higher lathe output both in quantity and quality. Contact your distributor today...or



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Ideal Live Centers feature precision machined and hardened ball and/or roller bearings for superior accuracy and performance. Sealed to keep dirt out, grease in.

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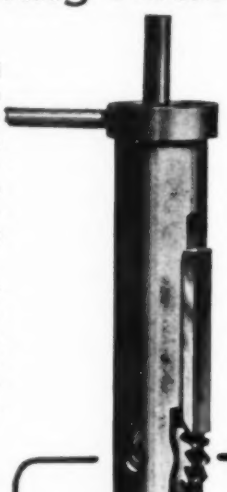
The INSIDE STORY about NATIONAL Keyseating Millers

NATIONAL Keyseating Millers are designed for milling internal keyseats . . . in one cut . . . in offset holes . . . with parallel sides . . . partly through holes . . . of standard width and depth . . . in holes that are closed at one end . . . and many other operations. A demountable guide on body of Miller enters keyseat being milled assuring straight keyseat in perfect alignment with the axis of the bore, thus making it unnecessary to clamp work to drill press table.

CUTTERS are made from high speed steel which are hardened to Rockwell specifications and accurately ground to size. Tops of teeth are staggered to break chips which reduces strain and wear on both cutter and driving pins. It will pay you to put National Keyseating Millers on the inside of your next keyseating job.



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trated. Use of manually operated 100w and 1000w units for light and heavy duty soldering and brazing is discussed.

16 ELECTROSLAG WELDING—*Arcos Corp, 1500 S 50th St, Philadelphia, Penna.* 4-page illustrated bulletin, form 55914, discusses the process, compares it with submerged arc welding, and describes the Vertomatic machine designed to weld sections within the range of 1¼ to 14 in. thick with standard size ⅛ in. (3mm) dia wire. Includes table showing variables used on typical welds with different thicknesses of material; gives mechanical properties of electroslag welds made with composite wires on samples which were not heat treated.

17 MELTING PROCESS—*Firth Sterling Inc, 3119 Forbes Ave, Pittsburgh 30, Penna.* 8-page brochure on Hopkins Process (Stereon H) outlines relative merits of material produced by the process, illustrates them with photographs of macroetch disks. Tables showing physical properties at room and elevated temperatures illustrate the uniformity of Stereon H A-286, Discaloy, SAE 4340, and 16-25-6.

18 ELECTRODE DATA CHART—*National Cylinder Gas Division, Chemetron Corp, 840 N Michigan Ave, Chicago 11, Ill.* 25 x 30-in. chart lists 25 items of comparative information on more than 130 of the most commonly used electrodes. Data furnished on mild steel, and low-alloy, low-hydrogen and stainless steel electrodes; includes ASTM-AWS classification, NEMA color codes, type of current and chemical requirements including carbon, molybdenum, chromium, manganese, silicon, sulfur, nickel, and vanadium.

19 ARC WELDING CABLE CONNECTIONS—*Tweco Products, Inc, PO Box 666, Wichita, Kans.* 12-page catalog 12 illustrates and describes complete line of connections and accessories. Specifications and prices included.

PLANT SERVICE EQUIPMENT

● BATTERY ELECTRIC INDUSTRIAL TRUCKS—*Electric Industrial Truck and Allied Products Manufacturers, Suite 758, One Gateway Center, Pittsburgh 22, Penna.* 18-page booklet covers construction features and operating characteristics. Installations and applications illustrated; advantages discussed. Section devoted to

"He made it his business to learn how to operate every machine in the shop—now that's his job."

At arctic temperatures and supersonic speeds

...what happens to aircraft skin?

Technicians of Aircraft X-ray Labs, Huntington Park, Calif., radiograph fin of aircraft at -65°F

WITH AIRCRAFT POWER mounting, with speeds that leave sound behind, extremely high frequency vibrations were bound to build up. What would be their effect on aircraft structures—at temperatures ranging to 65°F below zero? To find out, radiography and Kodak Industrial X-ray Film, Type AA, were put to work.

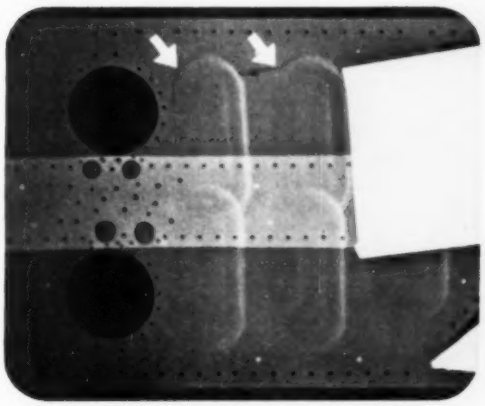
The radiographs revealed fatigue failures and gave clues to the nature of the stresses.

Exposures were made at target distances from 5′ to 15′ with exposures from 40 sec. to 90 sec. In spite of the cold, the film received no special handling.

All of which shows the importance of radiography as a test—also the dependability and versatility of Type AA Film.

If you build intricate assemblies, make castings or produce welded products, radiography can provide inside information as nothing else can. It can save time and money—improve foundry production and welding operations.

If you would like to know how it can help you, discuss it with your Kodak x-ray dealer—or with the Kodak Technical representative.



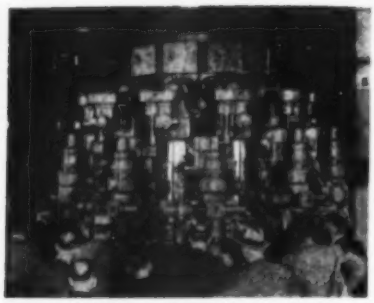
Radiograph reveals evidence of material fatigue under stress.

X-ray Division . . . EASTMAN KODAK COMPANY. . . Rochester 4, N. Y.

Read what Kodak Industrial X-ray Film, Type AA, does for you:

- Speeds up radiographic examinations.
- Gives high subject contrast, increased detail and easy readability at all energy ranges.
- Provides excellent uniformity.
- Reduces the possibility of pressure desensitization under shop conditions.

Kodak



An 80,000-pound ten-spindle gear shaper

Read the fascinating human story of

Precision Valley

THE MACHINE TOOL COMPANIES OF SPRINGFIELD, VERMONT

by Wayne G. Broehl, Jr.

Here for the first time ever published is the saga of the machine tool industry of the United States. It is woven around three staunchly independent, Yankee-ingenuity companies, located on the Black River at the foot of seven towering hills — in a setting reminiscent of a Swiss mountain village.

Although the Jones and Lamson Machine Company, the Fellows Gear Shaper Company, and the Bryant Chucking Grinder Company are today internationally famous —

- What key inventors and inventions, windfalls, and financial bootstrap operations were were involved in their beginnings?
- How have they survived severe cyclical swings and wildly fluctuating profits during wars, booms and depressions?
- How have they enlisted local support?
- How has "outside" labor and the union movement affected them?
- What is America's vital stake in the survival of this relatively small but all-important industry?

In these pages you'll find thought-provoking ideas about the problems of delayed obsolescence purchasing, higher speeds and increased automation, women in the machine tool industry, bigger sales and smaller profits, post-war machine dumping, factors in downturns, the apprentice situation, material priorities, foreign markets, charging for outside problem-solving, mergers, new models and lower manufacturing costs to meet sales slumps, diversity of items vs. specialization, and many more.

PRECISION VALLEY *is a must* for the machine tool executive who must think and plan ahead. History repeats itself. Experience is the best teacher. This RECORD belongs in your arsenal of information.

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Free Literature

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power source contains information on batteries, chargers, motors, and controls. Request direct on company letterhead.

20 PACKAGED AIR CONDITIONERS— *Acme Industries, Inc, 600 N Mechanic St, Jackson, Mich.* 4-page illustrated catalog 571 describes line of Model ASC self-contained units which may be installed with or without duct work, may be air or water cooled, and are available in sizes from 3 through 15 tons. Dimensions and specifications given plus construction drawings and engineering data.

21 PORTABLE BLOWER - VACUUM CLEANERS—*Ace-Sycamore, Inc, 448 DeKalb Ave, Sycamore, Ill.* 4-page illustrated bulletin provides information on line including hand-portable units in 1-1/3, ¾, ½, and 1/3-hp sizes; a heavy-duty tank-type model; a new drum conversion unit for wet or dry pickup; a canister type for dry pickup only; plus a complete line of brushes, wands, sprayers.

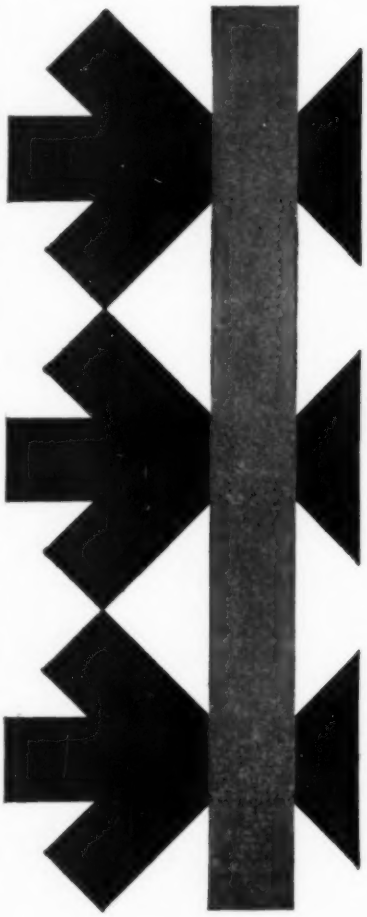
22 FIRE-FIGHTING EQUIPMENT — *Walter Kidde & Co, Main St, Belleville 9, NJ.* 16-page brochure P-49 describes and illustrates all types of portable extinguishers, wheeled units, built-in carbon dioxide extinguishing systems, and several types of fire detection devices. Chart indicates which extinguishers are approved for use on each class of fire—ordinary combustibles, flammable liquids, and electrical equipment.

23 FINISHING EQUIPMENT — *Lord Chemical Corp, 2068 S Queen St, York, Penna.* 4-page bulletin 1930E describes new 15-hp Lorco Vibrator added to line of units that employ controlled vibration for precision finishing of wide range of types, shapes, and sizes of metal, plastic, and wooden parts. Operation is said to be from 10 to 100 times faster than tumbling barrels. Specifications, construction features, standard equipment covered.

24 TRUCK OPERATORS' MANUAL — *Automatic Transportation Co, 149 W 87th St, Chicago, Ill.* 20-page Instructors' Manual is designed for use as a guide in training programs, covers theory of operation; good driving practices; demon-

"We gotta quit meeting secretly like this Alex; you know the boss 'll blow his stack if he catches us!"

V&O
LONG
SLIDE
PRESSES



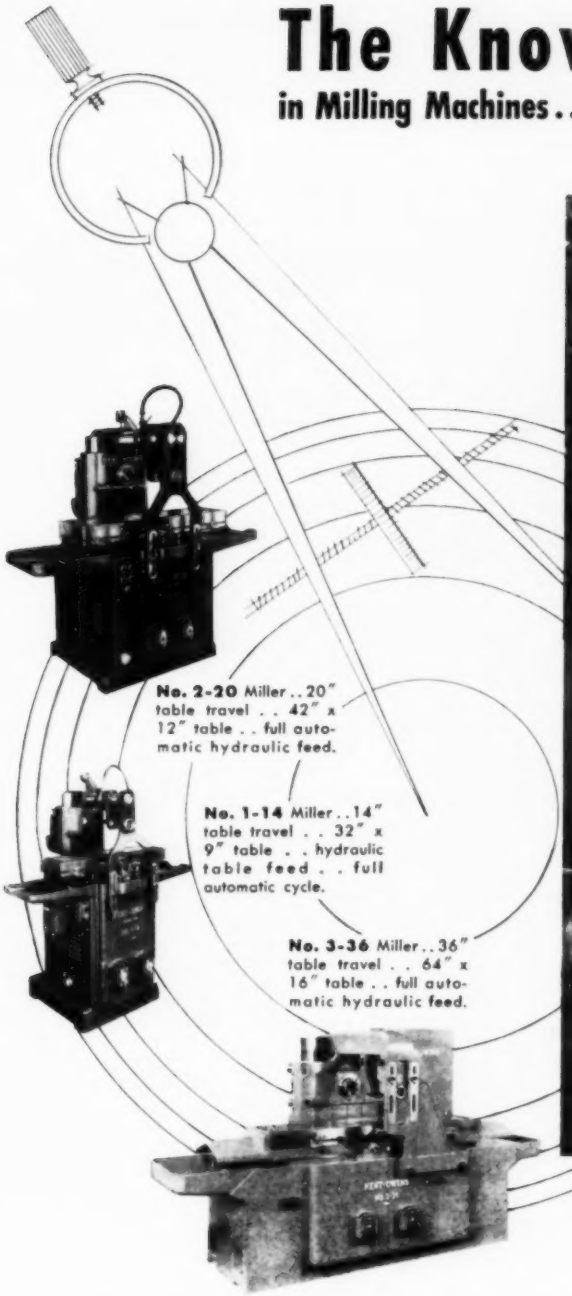
STILL
the most inherently accurate inclinables you can buy—and so the most logical for mechanized or automated operations.

Emhart Manufacturing Co.
Hudson, New York
V & O Presses and Feeds

EMHART

The Know-How Dimension

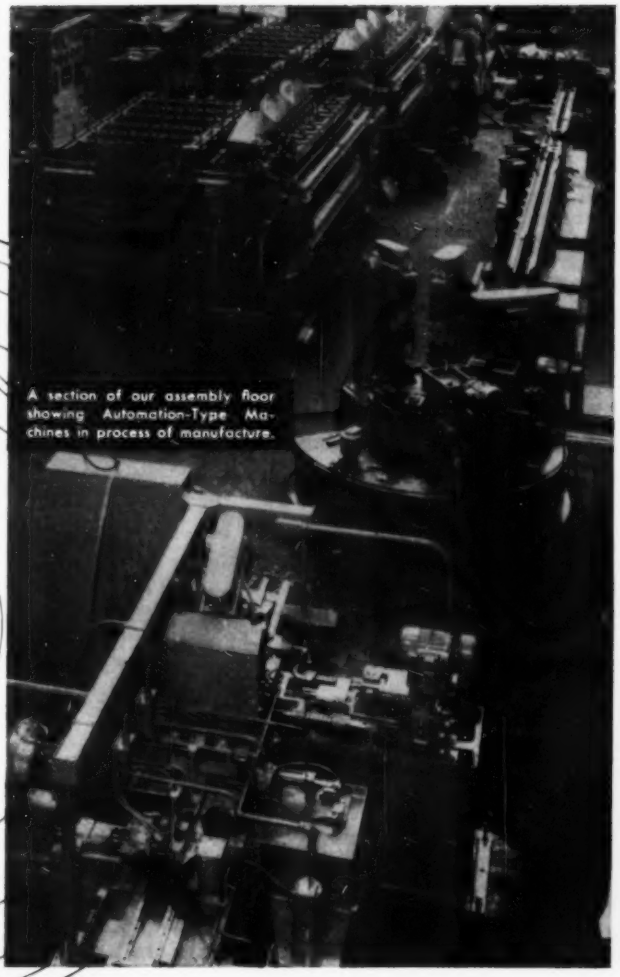
in Milling Machines . . Special Machinery . . Automation Equipment



No. 2-20 Miller . . 20" table travel . . 42" x 12" table . . full automatic hydraulic feed.

No. 1-14 Miller . . 14" table travel . . 32" x 9" table . . hydraulic table feed . . full automatic cycle.

No. 3-36 Miller . . 36" table travel . . 64" x 16" table . . full automatic hydraulic feed.



A section of our assembly floor showing Automation-Type Machines in process of manufacture.

. . makes the difference in cutting costs . . increasing production

Know-How, born of years of experience, abetted by sound and imaginative design and quality manufacturing standards . . . is the reason why many of our customers, representing a wide and diversified coverage of industry, come back to us again and again for *answers* to their production problems.

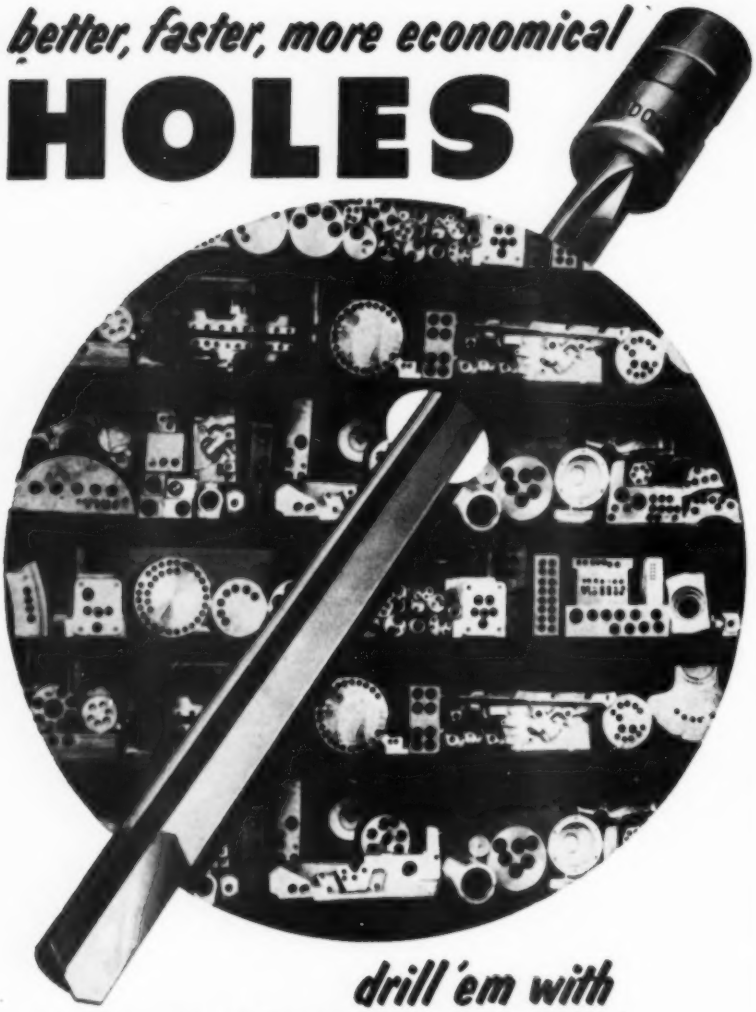
When you are considering procurement of machinery for your milling needs . . . or seeking the solution to other production problems . . . you may wish to consider a Kent-Owens Milling Machine or a Special Machine designed for a distinctive and individual application. Contract Machine Building (customer designed equipment) is another of our specialties.

Write or call . . . Kent-Owens will be pleased to quote your requirements. Kent-Owens Machine Company, Toledo 10, Ohio.

KENT-OWENS *Designers and Builders of Milling Machines and Special Machinery*

better, faster, more economical

HOLES



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ELDORADO*

GUN/DEEP HOLE DRILLS

Trillions and trillions of straight holes with ultra micro-finish, perfect size, absolute roundness and precision tolerance, *drilled in one operation*, in practically any material: steel, stainless steel, cast-iron, brass, aluminum, plastic, magnesium, titanium and other alloys. Thanks to ELDORADO *production-proved* DRILLS.

ELDORADO DRILLS can solve your 'hole' problem . . . small, large, short or deep, single or multiple set-ups.

ELDORADO with its modern and well equipped research facilities, constantly strives to design and develop better tools to help you eliminate your drilling problems. Avail yourself of this experience.

MADE TO YOUR SPECIFICATIONS:		AVAILABLE FROM STOCK:	
Sizes	.1250" to 2" dia.	1/8" to 1/2" dia. in 64ths	1/2" to 3/4" dia. in 32nds
OA Lengths	To 300 dia.	10", 16", 22", 36"	16", 22", 36"
Drivers	Std. or to fit your need	.750" dia. x 2 3/4" long	1" dia. x 2 3/4" long
Tips	Carbide	Carbide	Carbide
Now, order from stock, or send in your specifications for a prompt quotation.			

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Specializing 100% in Gun/Deep Hole Drills and Related Tools.

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(*) *Trade Mark*

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Free Literature

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stration and written examination for the driver trainee. Photos illustrate construction details of each model manufactured by Automatic. Causes and preventions of accidents covered.

25 BARREL FINISHING — *Tumb-L-Matic, Inc, St Mary's St, Stamford, Conn.* Monthly newsletter, "Tumb-L-Matic News," covers new equipment, compounds, and media, barrel finishing techniques applicable to metal, plastic, rubber, or wooden parts.

PARTS AND MATERIALS

● SCREW THREADS CHART—*Ohio Rod Products Co, 20259 First Ave, Berea, Ohio.* 8½ x 11-in. chart shows all details for Unified and American external screw threads with diagrams indicating terms for ordering. All specifications (0.060 through 1.0 in.) as well as thread symbol, allowance, max and min diameters, max and min PD's included. Request direct on company letterhead.

26 EPOXY PRODUCTS—*Carl H Biggs Co, 1547 Fourteenth St, Santa Monica, Calif.* Condensed catalog covers many new items and accessories useful in production where Helix epoxy bonding agents, potting compounds, sealants, and coatings are employed.

27 MULTIPLE-PLATE CLUTCHES — *Twin Disc Clutch Co, Racine, Wis.* Bulletin 134-C is a 4-page engineering summary on these units for machine tool applications; covers Model MTS, a single clutch, and Model MTU, a duplex unit built on a single hub. Both are available in 10 sizes with plate diameters ranging from 3 to 9 in. They can be furnished for either dry or wet operation. Complete specifications and dimensional data included as well as schematic diagrams of each model.

28 MINIATURE SPEED CHANGERS—*Metron Instrument Co, 432 Lincoln St, Denver 5, Colo.* Illustrated bulletin 96 describes new Series 2. Speed ratios are continuously adjustable over a 25:1 range (1:5 up to 5:1 down). Units handle torques from 5 to 40 oz-in. depending on the ratio setting; speeds up to 10,000 rpm; power to 0.025 hp; choice of worm gear, spur gear, thumb screw, lever or miter gear speed adjustment.

29 POLYDYNE DRIVES—*General Electric Co, Schenectady 5, NY.* 16-page bulletin GEA-6806 describes new ½-25-hp line of mechanical adjustable speed drives. Discusses principles of operation, config-

LATROBE Metalmasters...

working for you through BETTER High Alloy Die Steels

Fully-uniform
DESEGATIZED®
High Alloy Die Steels

- OLYMPIC FM
- BR-4 FM
- GSN FM
- COBALT CHROME FM

..for long-run dies!

Users of Latrobe's 12% chromium die steels pave the way toward greater production economy. Why? Because, as a result of Latrobe's exclusive DESEGATIZED® process, these steels are free of harmful carbide segregations —fully-uniform to insure maximum die results. Containing evenly-dispersed alloy sulphides, they are easier to machine . . . easier to work!

Put Latrobe Metalmasters to work on your long-run dies through using DESEGATIZED® High Alloy Die Steels . . . steels made by Metalmasters who *know* your production die requirements!

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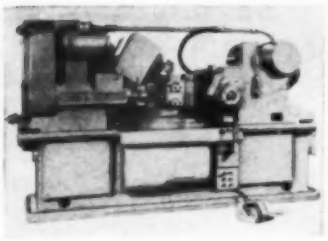
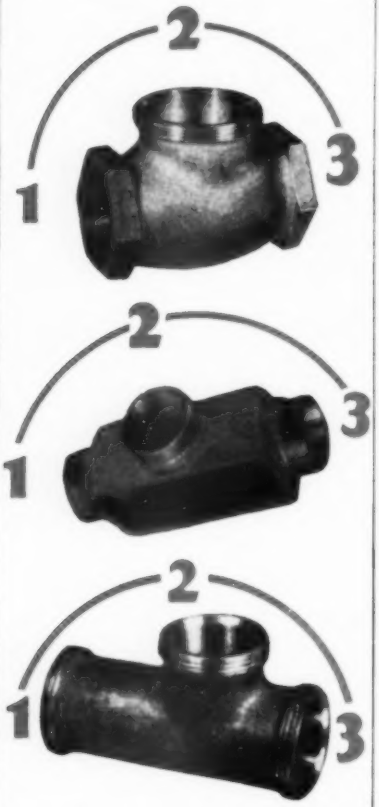
Here's what is meant by

"1·2·3"

in the

GOSS & DeLEEUW AUTOMATIC CHUCKING MACHING





The outstanding advantage of this machine is ability to handle operations on one, two or three ends of a *piece simultaneously or in sequence, without changing set-up or rehandling*. It is the only standard machine that will do this.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.

For complete details ask for illustrated bulletin. Send samples of your work for time and cost estimates.

GOSS and DE LEEUW
MACHINE COMPANY. KENSINGTON. CONN., U.S.A.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

urations, and features; includes mounting positions, rating tables, and description of accessories.

30 ALUMINUM BRONZE ALLOYS — *Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.* 4-page bulletin G-51 provides data on stock products available. These include extruded solid rounds, centrifugally cast bars, rolled sheet and plate, extruded rectangles, cast die blanks, and guide pin bushings. Sizes, physical properties, and applications listed.

31 DOUBLE ROW BALL BEARINGS—*Hoover Ball & Bearing Co, 5400 S State Rd, Ann Arbor, Mich.* 4-page bulletin 111 illustrates and describes bearings including open, shielded, and snap ring types, for applications requiring heavy radial loads, moderate thrust, shaft rigidity, and limited housing area. Dimension and load specifications for both light and medium series are provided.

32 BLIND RIVETS—*Huck Manufacturing Co, 2480 Bellevue Ave, Detroit 7, Mich.* 8-page illustrated brochure, Form 8-409, describes PT and 9SP units; lists advantages, recommended hole sizes, material specifications, shop practice notes, and shear and tension strength values. Typical applications pictured as well as the driving cycle (installation sequence) for each type discussed. Grip ranges for the full line in all sizes is tabulated.

33 STAINLESS STEEL—*Union Steel Corp, Union, NJ.* 4-page folder describes a sulphuric acid-resistant stainless called Union 20-S available in pipe, tube, strip, sheet, plate, bar, and wire. Includes general corrosion and welding information.

34 ROLLER BEARINGS — *Rollway Bearing Co, Syracuse 4, NY.* Catalog PL-559 contains information on the features, applications, and availability of company's nine principal lines. Includes range of sizes, specifications. Separate section covers special bearings for applications where special race configuration, material, or unusual construction is required.

35 HIGH-TEMP AIRCRAFT BOLTS—*Standard Pressed Steel Co, Box 875, Jenkintown, Penna.* 4-page illustrated form 2484 covers bolts for working temperatures up to 1600 F; previous high sustained temp for standard aircraft bolts was 1200 F. Charts and graphs, in addition to text, show comparative tensile and stress rupture strengths of typical 1615 series bolts fabricated from advanced metal alloys—M-252, Waspalloy, Udimet 500, or Hastalloy R-235. These charts show tensile strengths of from 85,000 psi to 110,000 psi at 1600 F; stress rupture strength for 100 hrs is shown as a minimum at 30,000 psi at 1500 F.

"Late or not, you'll use the parking lot!"

Test The DIMENSIONAIR Against Any Other Air Gage!

Set this gage quicker than you can set your watch. Once set, it stays set! *It can't drift.*

No need to keep a stockpile of dials. This 7½" *accurately calibrated, all-useable* scale will answer every normal gaging need. Operator cannot change magnification or monkey with your gaging tolerances.

Longer approach range. Greater plug clearance. Easier exploration. Longest useful life. Self-cleaning jets. No centralizing error.

NOTE:
Accurate setting is guaranteed with one master.

You will find the DIMENSIONAIR measures . . .

- **More Accurately**
- **More Dependably**
- **Faster** (Greater Plug Clearance)
- **With Less Maintenance Cost and with Less Dependence on Skilled Help . . . than any other air gage you can buy**

This is not just a claim . . . it's a statement we're ready to back up. We offer you the chance to try the Dimensionair on a "no strings-attached" trial basis in your own shop. But, if possible, try it in direct competition with any other leading air gage so there will be no doubt in your mind about the best gage to use.

MAIL THIS EASY-TO-CLIP COUPON *TODAY!*

Federal Products Corporation
912b Eddy Street, Providence 1, R. I.

O. K. Prove it! Let us try a DIMENSIONAIR.

Name _____ Company _____

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Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

4-col. presses bristle with production-boosting features

KRW has done it again! This time, the 25-1000 ton KRW line of 4-column, single action hydraulic presses has been modernized to set a new pace over a broad work range.

Bristling with newness, these smooth-acting machines are built to outperform even KRW's highly regarded, prior designs in a wide variety of assignments: Blanking, forming, punching, trimming, drawing, extruding, briquetting, straightening, pressure clamping, laminating and bonding.

Already acclaimed "a marked success," KRW's latest version of the 4-column press boasts numerous features to improve quality and increase productivity: Of rugged, welded steel construction, the crown, bed and sliding platen provide maximum resistance to deflection. Align-bored to automatically controlled tolerances, the sliding platen is guided on ground and polished columns which are closely fitted into the crown and bed.

Easy to adjust, KRW hydraulic systems assure instant, complete press control. Compactly designed, the pumping unit can be mounted at the top of the press or furnished for floor installation.

Available with either up-acting or down-acting platens, KRW 4-Column Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling.

For detailed information and specifications, write for Bulletin 95-D. K. R. Wilson, Inc., 212 Main St., Arcade, N. Y.

KRW HYDRAULIC PRESSES

CIRCLE 278 READER SERVICE CARD

James N F Reynolds Jr has been named vice president, manufacturing, for Van Norman Industries, Inc, New York. He was formerly with the management consultant division of the Scovell Wellington Co

Gilbert L Holt has been named vice president, manufacturing, for the American Car and Foundry Division of ACF Industries, Inc, New York. He was formerly works manager of the division's Berwick, Penna, plant

James H W Conklin has been appointed general sales manager of Pratt & Whitney Co, West Hartford, Conn. For the past three years he has been a management consultant in sales and marketing and prior to that was general sales manager of Yale & Towne Manufacturing Co's Material Handling Division

NAMES IN THE NEWS...

Edwin M Miller, head of the machinery manufacturing division of Lincoln Electric Co, Cleveland, has been elected a vice president of the firm. Also named vice presidents: **George F Willis,** head of the electrode manufacturing division; **Robert A Wilson,** in charge of application engineering service, developing procedures and techniques for applications of arc welding.

Robert A Jentsch has been appointed manager of manufacturing of the Hydreco Division of New York Air Brake Co, Kalamazoo, Mich. He was formerly associated with Automatic Transportation Co, Chicago, as general superintendent.

Gerald J Lynch has been elected a vice president of Ford Motor Co. Mr Lynch is general manager of Aeronutronic which was established as a company division July 1 when Aeronutronic Systems, Inc, was merged with Ford.

George A Saar has been appointed assistant to the vice president of Allis-Chalmers' Industries Group. He was previously manager of the electrical department at the Norwood (Ohio) Works. **Earl S Evans** has been named assistant chief engineer of the Steam Turbine Department. He was formerly engineer in charge of the project section in the department.

R K McConkey has been promoted from assistant general manager to general manager of the Industrial Division of Timken Roller Bearing Co, Canton, Ohio. **A E Matejka** moves up from assistant to chief product engineer.

Manuel Tama has been named vice president in charge of the Ajax Engineering Division of Ajax Magnethermic Corp, Youngstown, Ohio. He was formerly president of Ajax Engineering Corp, Trenton, NJ. **Melvin A Raney** has been appointed vice president in charge of the Ajax Electrothermic Division, Trenton. He was formerly in charge of manufacturing for the Taylor-Winfield Corp, Warren, Ohio. Earlier this year the two Ajax companies were joined with Magnethermic Corp.

Stephen Miller (left) has been appointed sales manager of the Machine Tool Division of Clearing division of US Industries, Inc. He was formerly associated with Union Carbide & Carbon Corp in St Louis. **David L Dumond** has been named chief engineer at Clearing. He was previously engineering manager for the Cross Co in Detroit

Chester S Johns, general sales manager of Buhr Machine Tool Co, Ann Arbor, Mich, will assume all of the duties formerly handled by **A A Vetter,** vice president, sales, who has left the company

One order, one source
. . . every fastener need

Eliminate delayed deliveries!

Production line techniques require positive deliveries and fast service. Orders for So-Hard standards are processed for shipment the day they are received. This specialized service backs up distributor supplies—eliminating delayed deliveries.

For added measure, famous So-Hard fasteners have proven their worth—for nearly a century. Whether you order by the carload or by individual packages, there'll be no rejects, no seconds . . . only quality precision-made products. Specials on order. VMA 6541

SCREW AND BOLT CORPORATION OF AMERICA P.O. Box 1708 Pittsburgh 30, Pa.

Formerly Pittsburgh Screw and Bolt Corporation

SERVES THE NATION

America's Most Complete Line of Industrial Fasteners

NAMES IN THE NEWS . . .

Lawrence A McDonald, sales manager of Super Tool Co, Detroit, has been elected vice president, sales

Delmar D Robertson, formerly vice president, sales, of the Dana Corp, Toledo, has been appointed vice president in charge of automotive engineering at the Budd Co. He will make his headquarters at Budd's Charlevoix plant in Detroit.

Richard W Phelps has been appointed general manager of Black-Clawson Co's Dilts Division, Fulton, NY. Formerly manager of engineering and product development for the division, Mr Phelps succeeds **Robert J Jacobs** who has resigned.

Richard M Wirth has been elected president of Morgood Tools, Inc, Rochester, NY, manufacturer of cutting tools for automatic screw machines. He succeeds **Ben John Goodman. A A Marshall** has been appointed vice president, and **Carl C Bunde** chief engineer.

M Carl Haddon has been named a vice president of Lockheed Aircraft Corp and general manager of its new Electronics and Avionics Division. He fills the post left vacant by the recent death of **Louis N Ridenour.** Mr Haddon was formerly California Division chief engineer.

Weldon C Miles, vice president and general manager of American Engineering Co, Philadelphia, has been elected president of the firm.

George Beckwell has been named research and development engineer at Pines Engineering Co, Aurora, Ill, manufacturer of bending machines and presses. He moves up from the post of service engineer.

Plant Sites Are Available in

It's OLD Industrial Country

If you're interested enough to weigh Bristol as your new industrial home, you can select an actual site for your new plant or expansion. Bristol's campaign for new industry leaves nothing to the imagination as do so many efforts of communities less experienced in living with industry than Bristol.

You see, Bristol has been an industrial center for years and our available plant sites were chosen with real know-how . . . the same know-how with which we located the new plants of Sperry-Farragut Corp., Raytheon Corp., Monroe Calculating Machine Co. and Burlington Industries.

Nothing succeeds like success and it will pay you to concentrate on the Bristol community as the site for your new facility. Our folks know what you need and are anxious to provide it. Let us show you our plant sites in industrial Bristol, Tenn.-Va.

Let Ford, Bacon & Davis Tell You The Whole Story

This nationally famous engineering firm has prepared an exhaustive analysis of Bristol's industrial potential. Write for your copy today. Please address Dept. M 859.

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INDUSTRIAL DEVELOPMENT BOARD
of the Twin Cities of
BRISTOL • TENN. - VA.

CIRCLE 280 READER SERVICE CARD
CIRCLE 281 READER SERVICE CARD

Quality . . . the best economy of all

He's mopping up the mess for the last time

At a leading aircraft research center, high-frequency vibration caused severe oil leakage from hydraulic lines servicing a huge wind tunnel. Many man-hours each month were wasted cleaning up the basement floor underneath, even though drip pans were used extensively.

Now, after a change to a Suntac oil, the vibration-caused leakage has been reduced to a point where "mop-up" is not needed. Hydraulic-fluid consumption has been cut by 4000 gallons a year. That's economy! That's Sun quality—the best economy of all.

If your plant is troubled with a leaky system, a Suntac antileak hydraulic oil can save you money, too. Ask your Sun representative to show you the Suntac desk-top demonstration, or write direct to SUN OIL COMPANY, *Philadelphia 3, Pa., Dept. AM-8. In Canada: Sun Oil Company Limited, Toronto and Montreal.*

SUNOCO

MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

CIRCLE 282 READER SERVICE CARD

What's glue got to do with the price of finishing?

Stuck? Then you'll be interested to learn that glue is but one of several bonds used to hold the cutting grains to the backing in the manufacture of coated abrasives. Varnishes and resins are also common bonding materials. The problem is to select the proper bonding material to assure maximum belt life. Jewel Brand Abrasive Engineers know, for example, that glue is commonly recommended for dry, low heat applications while resins are usually required where toughness and resistance to water, heat and high working pressures are in demand. Their ability to recommend the proper bonding material often results in substantial savings in time, labor and materials. It will pay you to put their knowledge to work for you. Write for complete details. Abrasive Products, Inc., 561 Pearl Street, South Braintree, Mass.

belts
rolls
sheets
discs
specialties

JEWEL BRAND

COATED ABRASIVES

ABRASIVE PRODUCTS, INC., South Braintree 85, Massachusetts

186 CIRCLE 283 READER SERVICE CARD

IN THE NEWS . . . NAMES

R B Smith has been named regional sales manager of National Acme Co's western district territory, including Canada. Formerly sales engineer in the Newark, NJ, territory, he will headquarter in the company's main office in Cleveland.

Horace B Van Dorn, technical development manager at Fafnir Bearing Co, New Britain, Conn, has been appointed director of engineering. **Francis G Patterson,** chief engineer in charge of research, has been named chief product engineer. **Philip K Pearson Jr** has been made chief plant metallurgist.

Lou Gruenkemeyer has been named head of manufacturing and purchasing at the Vac-U-Lift Co, Salem, Ill, division of the Siegler Corp. **Charles Boger** is in charge of engineering; **Fay Murphy,** product design; **John Watson,** sales; and **Richard Warfel,** sales engineering.

Joseph F Richards has been appointed component product manager of Sterling Precision Corp's Instrument Division, Port Washington, NY. He will be in charge of engineering, manufacturing, and sales of all electro-mechanical and standard components.

Lee H Hill has been elected president of Burdett Manufacturing Co, Chicago maker of finishing systems, gas-radiant heat systems, and furnaces. He succeeds **Mrs Esther B McCormick,** named board chairman. For the past twelve years Mr Hill has been a partner in Rogers, Slade and Hill, New York consultants on management problems.

George V Agajeenian, vice president and general manager of Univex Die Cast & Engineering Co, Dearborn, Mich, has been elected president of the company.

Arthur J Ringman has been appointed assistant vice president of National Can Corp and manager of sales of the Atlantic Division. He was previously sales manager of the Division's southeast district.

Harry H Jason has been appointed manager, Atlantic district, of General Electric Co's Metallurgical Products Dept. He has transferred from Atlanta where he served as manager of the department's southern district.

PLANT IDENTIFICATION No. 858
PASS Harold Dilway
POSITION Methods Engineer
DEPARTMENT Production
This pass issued to the person whose photograph and signature are affixed hereon. It is not transferable and use by another individual will result in its being revoked without notice.
SIGNATURE Harold Dilway
WEBSTER & HALPERN MACHINERY INC

"There's so much new stuff breaking"

"With the new South works on two shifts and our automatic model making sales records, the boys in the shop really have us hopping. Time was when I could keep up with new equipment and methods by talking to salesmen and our own people. But things are changing so fast now and we're so rushed, I have to keep up by reading at home nights."

This is a real problem for the hard-pressed engineers and executives in Metalworking. They have to keep pace with fast-breaking technical developments in a dynamic field. Reading a publication like American Machinist is something they can't afford to ignore.

American Machinist gives them what they want and need to know – fast. Cover to cover, it's production-minded. This is why it's consistently the "most useful" publication in its field. It's one of the reasons why more production men subscribe to it than to any other Metalworking publication. It's also why so many of them say . . .

"I have to read American Machinist"

While both Mr. Dilway and his company are hypothetical, they are typical of men and firms in Metalworking. American Machinist will gladly provide real buying-action verbatims from actual men in Metalworking.

McGraw-Hill Magazine of Metalworking Production
330 West 42nd Street, New York 36, New York

Time:

It's *standard* time. Time to consider how Hanson-Whitney's *standard* cutting tools and gages can be economically used in your particular application. Hanson-Whitney's new production techniques have resulted in better *"free-cutting action"* tools for consistent production. These modern developments protect your investment through the entire threading process. By reducing production variables, Hanson-Whitney can offer important savings to your profit dollar.

Complete and Related "STANDARDS"

Your Hanson-Whitney distributor can save you time with a single source line of *complete and related* threading tools and gages. Your Hanson-Whitney distributor is the threading specialist providing these services—backed up by Hanson-Whitney's forty years of thread engineering and experience.

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COMPANY

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STANDARD: Taps • Thread Gages • Cutters • Fine Pitch Gear Hobs

NAMES IN THE NEWS . . .

R Thornton Beeghly has been elected president of Metal Carbides Corp, Youngstown, Ohio, producer of Talide tungsten carbide metal. Formerly vice president and general manager, he succeeds his father, **L A Beeghly**, founder of the firm.

John I Cheney has been appointed West Coast district manager of J H Williams & Co, Buffalo manufacturer of wrenches, tools, and drop forgings. Mr Cheney is now in charge of the company's district office and warehouse in Los Angeles.

John W Decker has been named sales manager of Shear-Speed Chemical Products, Hazel Park, Mich, producer of cutting oils and coolants, and a division of Michigan Tool Co.

Paul S Nurko has been promoted to works manager of De Laval Steam Turbine Co, Trenton, NJ. He was previously general superintendent of the manufacturing division.

Robert N Mitchell has been promoted from quality control manager to general superintendent of Marchant Calculators Division of Smith-Corona Marchant Inc, Oakland, Calif.

Walter M Hassenplug, vice president and director of engineering at Acme Industries, Inc, Jackson, Mich, maker of refrigeration and air conditioning systems, has been named executive vice president. **Henry R Krueger,** project engineer, has been appointed director of engineering.

William T Cherry, manager of application engineering at Formsprag Co, Warren, Mich, manufacturer of overrunning clutches, has been named district manager of the West Coast area with headquarters in Los Angeles.

N C Hunt, founder of the Hunt Valve Co, Salem, Ohio, has resumed duties (after a period of retirement) as president and board chairman. **Lester A Bateman** has been named executive vice president and **Andrew V Ney** sales manager.

OBITUARY

Erwin Loewy, 62, founder and president of Loewy-Hydropress, and a vice president of the parent company, Baldwin-Lima-Hamilton Corp, died July 13 in New York.

AUTOMATIC PRODUCTION is faster, more accurate, more profitable

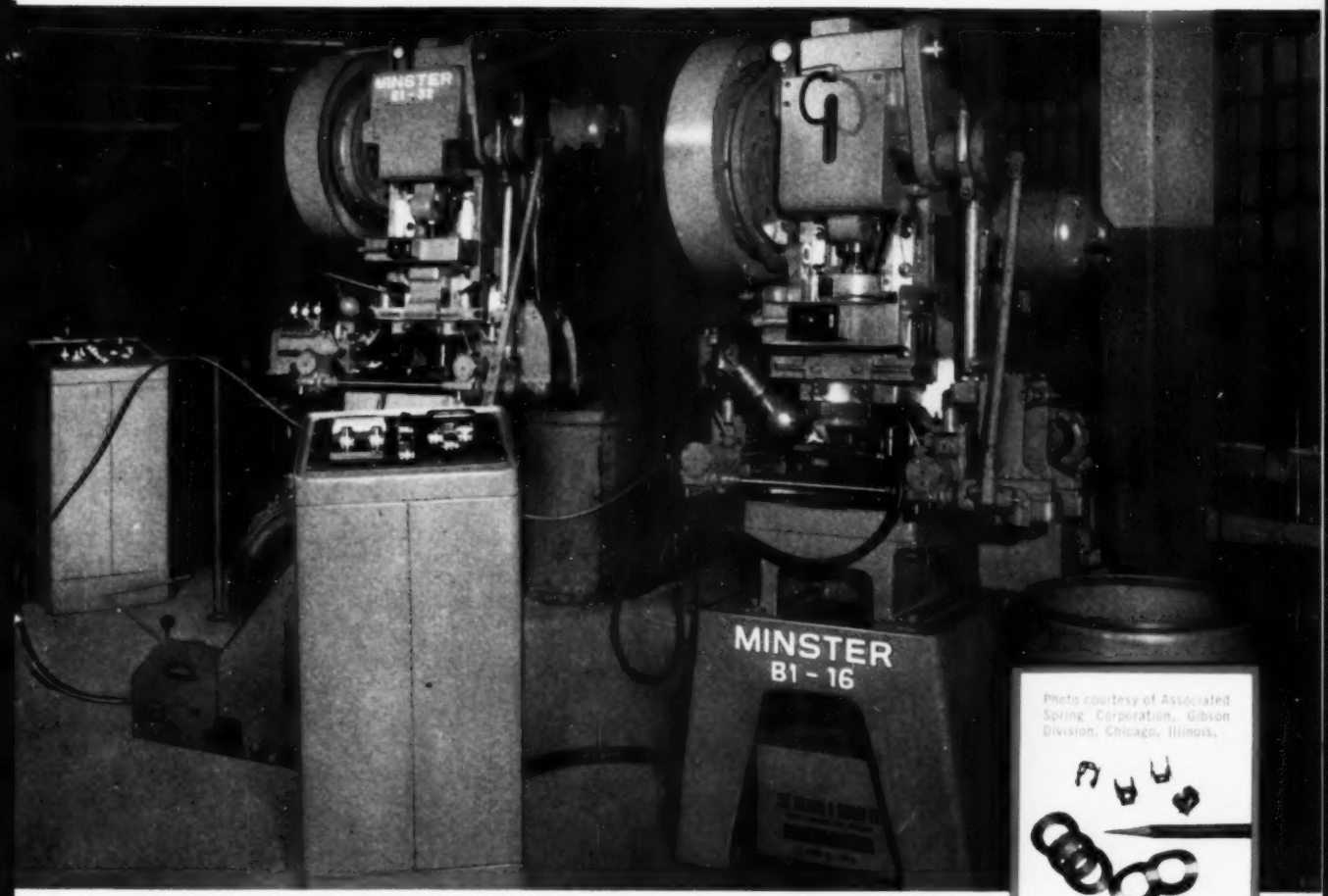


Photo courtesy of Associated Spring Corporation, Gibson Division, Chicago, Illinois.

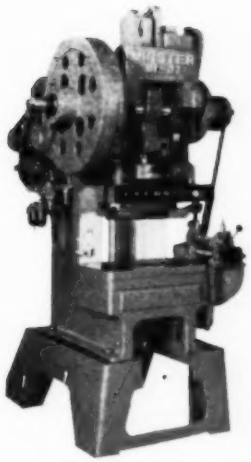
Minster B1 High Speed Gap presses range in capacity from 16 to 60 tons. They're compact and highly efficient for long or short run small parts production from coil stock.

Minster B1 High Speed Gap Presses

You gain in many ways when you run single or multi-stage jobs automatically at high speeds. You increase production and slash costs. Less equipment is needed, cost per part is lower and that means more profit.

Automatic production is always *most* profitable when you take advantage of Minster's technical knowledge and wide range of presses and feed equipment. Minster matches the proper type and size of press and feed to your requirements . . . gives you maximum versatility in material size and job selection.

Let us show you the best way to run your jobs automatically—at greater profit. Write or call today.



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Questions from the floor

Are you getting most floor absorbent bulk (not weight!) for your money?

Does your floor absorbent become saturated before it does its job?

Does your floor absorbent create new hazards by absorbing light, thus reducing needed working light?

Does your floor absorbent "mud up" with oil and water?

THERE'S A TEST THAT ANSWERS ALL THESE QUESTIONS

In less than 15 minutes in your own office, you can get all the right answers scientifically. Our Eagle-Picher representative will bring a miniature laboratory right to your desk. Compare Eagle-Picher Floor-Dry with any other floor absorbent. See which wins out on overall economy and full-range safety. Eagle-Picher is eager to face comparative tests. Write today.

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NEW BOOKS...

MECHANICS; PART I, STATICS — *By J L Meriam, Professor of engineering mechanics, University of California. Published by John Wiley & Sons, Inc, 440 Fourth Avenue, New York 16, N Y. Second edition. 393 pages. Price $5.00*

The author says that mechanics is based on surprisingly few fundamental principles. He has emphasized these and their applications, and has reduced and eliminated much secondary detail. This new edition of the book includes a new section on review problems and one on vector algebra. Some other sections of the book have been rearranged and updated.

Sketches are liberal, and there are problems at the end of each chapter to illustrate solution methods. General topics covered include forces, equilibrium, structures, distributed forces, friction, and work. Vectors, moments of inertia, and a number of tables are appendixed.

•

GRAPHICAL COMMUNICATION—*By Earl D Black, Head of engineering drawing and kinematics, General Motors Institute. Published by McGraw-Hill Book Co, 330 W 42nd Street, New York 36. 328 pages. Price $8.00.*

Has any other engineer ever found it imcomprehensible that anybody even slightly connected with mechanics, or a shop of some kind, could have much trouble in reading a blueprint? Sure, some of them are complicated, and they require perusing like a book. But practically any blueprint can be read by almost anyone who takes the time—or can it?

Evidently not; and that is the reason for this book—aimed at high school and shop-apprentice levels, and equally suitable for more experienced people who are not up to snuff on graphic symbols and standards for machinery and architectural drafting.

It's a good book, too; including a great deal of useful reference data. It covers blueprint reading, drafting standards, machine and process drawings, tools and dies, house and building plans. The glossary is extensive, including terms of practical use in machine and building construction. There are extensive tables of screw-thread sizes, cylindrical fits, geometric figures, and the like. There is plenty in the book of value even for experienced engineers.

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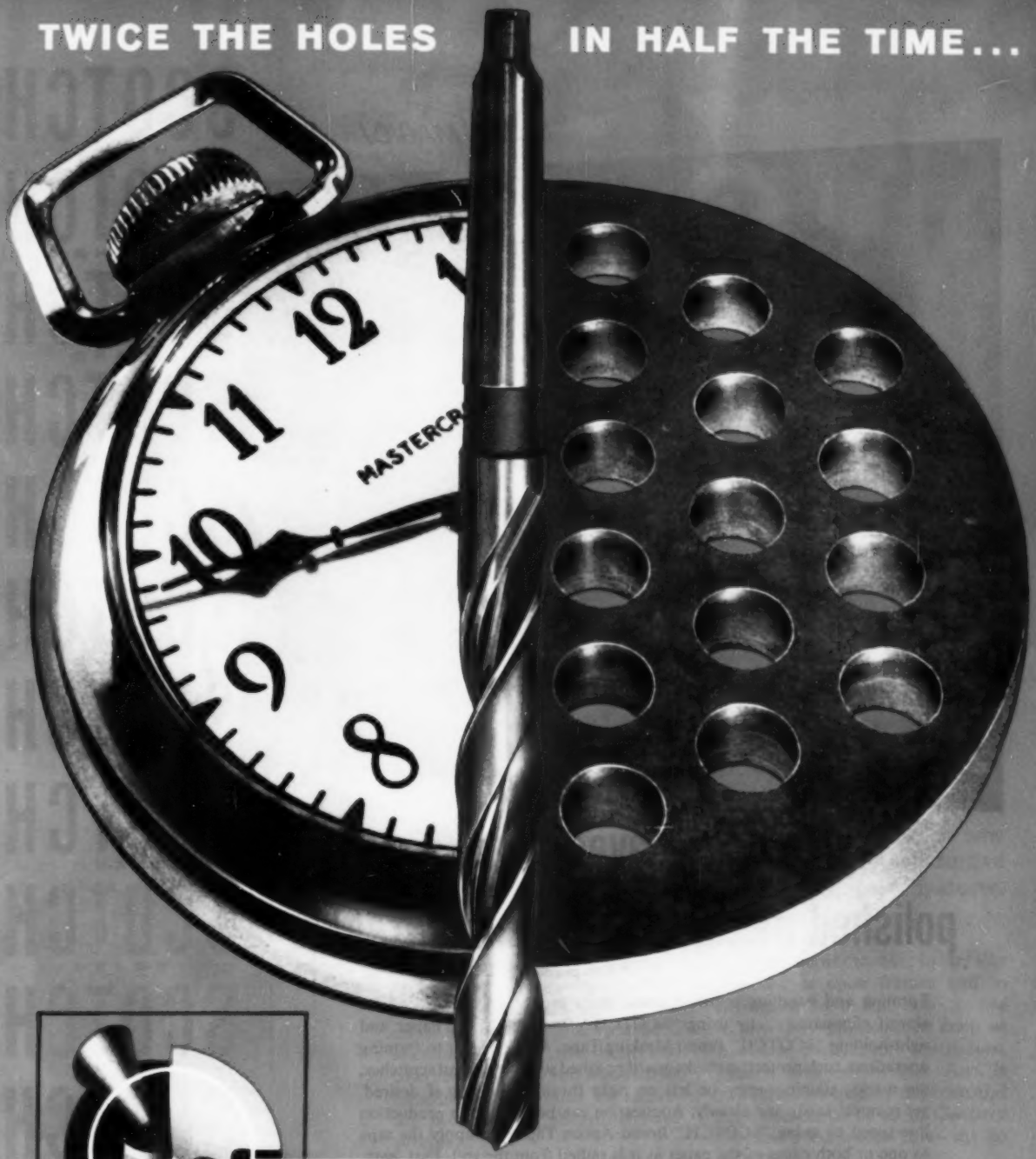
TWICE THE HOLES IN HALF THE TIME...



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with the new SPEEDICUT "CHIPBREAKER," the drill with the patented rib that permits 50% to 400% higher feed rates, cuts production time and costs.

Have the *SPEEDICUT "CHIPBREAKER"* demonstrated in your own plant on your own equipment and type of work. Write for literature and name of your local authorized distributor.

SPECIFY
SPEEDICUT "CHIPBREAKER"
SPEED WITH SAFETY

SPEEDICUT DIVISION, CHICAGO HEIGHTS STEEL CO. • CHICAGO HEIGHTS, ILL.

It's 3M MAGIC!

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TAPEnology saves "face"... polished metal stays blemish free!

Forming and handling polished metal sheet can be speeded . . . rejects almost eliminated . . . by using "SCOTCH" Brand Masking Paper and tight-holding "SCOTCH" Brand Masking Tape. Applied prior to forming operations, such protective masks guard polished surfaces against scratches, die marks, staining—may be left on right through shipping if desired, yet removes easily and cleanly. Application can be kept up to production line speed by using "SCOTCH" Brand Apron Tapers to apply the tape to one or both edges of the paper as it is pulled from the roll. Fast, easy, economical . . . the cost-saving way to increase handling speeds on flat, polished metal stock.

Looking for Cost Saving Short Cuts? No matter what your metal-working operations include, chances are "TAPEnology" can help you do it faster, better, at less cost. Ask your nearest "SCOTCH" Brand Tape Distributor for complete information, or write: 3M Co., St. Paul 6, Minn., Dept. 1AA-89.

When tape costs so little, why take less than "SCOTCH" Brand?

"SCOTCH" is a registered trademark for the pressure-sensitive adhesive tapes of 3M Co., St. Paul 6, Minn. Export: 99 Park Ave., New York 16. Canada: London, Ontario.

MINNESOTA MINING AND MANUFACTURING COMPANY
. . . WHERE RESEARCH IS THE KEY TO TOMORROW

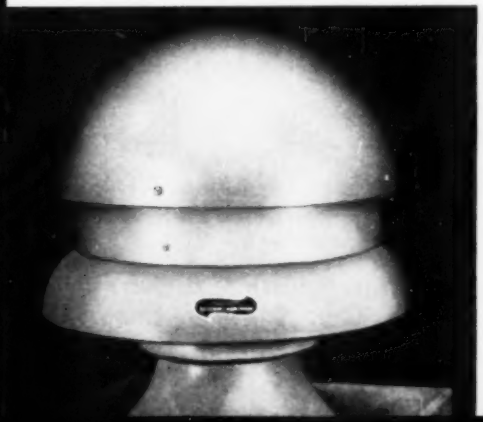
3M COMPANY

Century Electric 5 hp short motor is 4⅞ inches shorter than standard 5 hp motor.

This new Century Electric motor is up to five inches shorter

(above) Standard flange gives flexibility in mounting. Motor can be installed horizontally or vertically.

(below) This compact power roof exhauster is typical of applications for short motors.



You have greater product design freedom with the new Century Electric short motor. It is two and a half to five inches shorter, but has all standard integral motor features. Here are the benefits:

Save space and weight— Your product can be smaller, lighter, a different shape . . . because the new motor is up to 35% shorter and has less bulk and overhang. Means you also reduce handling costs—both in receiving motors and shipping your product.

Easy mounting— You can use this motor in place of any standard end-mounted motor because it has a standard flange. It can also be mounted horizontally, vertically, or at any angle. Its small size makes it possible to mount the motor in a variety of places on equipment.

Variety of applications— You can get the new Century Electric short motor in totally enclosed or open frames and in ratings up to 15 hp. You can use it on many applications such as machine tools, roof ventilators, pumps and centrifuges. And it has the same quality features and high standards of all of Century Electric's complete line—up to 400 hp.

More than a motor— This motor is the result of a continuing search for ways to meet industry's needs. Another reason why you get more than a motor from Century Electric.

For more information, contact your nearest Century Electric Sales Office or Authorized Distributor.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

CIRCLE 290 READER SERVICE CARD

Century 59-3

UNIVERSAL JIG AND FIXTURE COMPONENTS AND CLAMP ASSEMBLIES

Shown here are a few of more than a thousand different items in regular steel and stainless steel —the largest and most complete selection in the United States—now available from Universal Engineering Co. Write today for your copy of the complete, new catalog.

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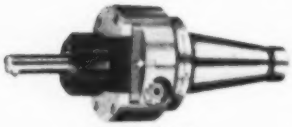
OTHER PRECISION-BUILT COST SAVING UNIVERSAL PRODUCTION TOOLS

Floating Chuck

Standard Collet Chuck

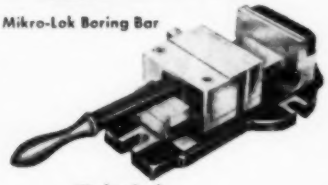
Mikro-Lok Boring Bar



Boring Chuck

"Kwik-Switch" Tool Holder

Standard Drill Bushing



Wedge-Lock Production Vise

UNIVERSAL ENGINEERING COMPANY, FRANKENMUTH 1, MICHIGAN

4 Types of Multi-Unit Automatics for High Production to Close Tolerances

Each of these four machines on our assembly floor is a different type. Each one is the most efficient setup for its particular job.

But these different types of machines are alike in these ways —

- **Operations.** Drill, counterbore, ream, tap, mill (light cuts), etc.
- **High production.** A number of automatic units of ½ to 5 hp each perform different operations at the same time.
- **Close tolerances. Few rejects. Little downtime.** Each machine has good basic design and rugged accurate construction.
- **Ready to produce.** Samples run for approval before shipping machine.

For a specific proposal ask our representative in your area. Or write us. Kingsbury Machine Tool Corp., Keene, New Hampshire.

REPRESENTATIVES

California	Los Angeles 22	Moore Machinery Co
Connecticut	West Hartford 7	O C Stevens Mchy Co
Illinois	Chicago 51	Four States Mchy Co
Indiana	Indianapolis 20	C C Garrett Mchy
Michigan	Detroit 19 Grand Rapids 4	Birmingham & Conner Joseph Monahan
Missouri	St. Louis 24	R R Stephens Mchy Co
New York	Long Island City Syracuse 1	Triplex Mach Tool Co Syracuse Supply Co
Ohio	Cincinnati 2 Cleveland 3 Dayton 2	E A Kinsey Co Golden & McCoy Co C H Gosiger Mchy Co
Pennsylvania	Philadelphia 6 Pittsburgh 37	John S Wright, Mchy Merit Machinery Inc
Canada	Toronto 8	Barker Indus Eq Ltd

REGULAR INDEXING

For most high production work. Perform successive operations from one direction or several. Index units in four sizes: 12-, 20-, 26- or 40-inch. Four to 10 stations (12 with 40-inch).

CENTER COLUMN INDEXING

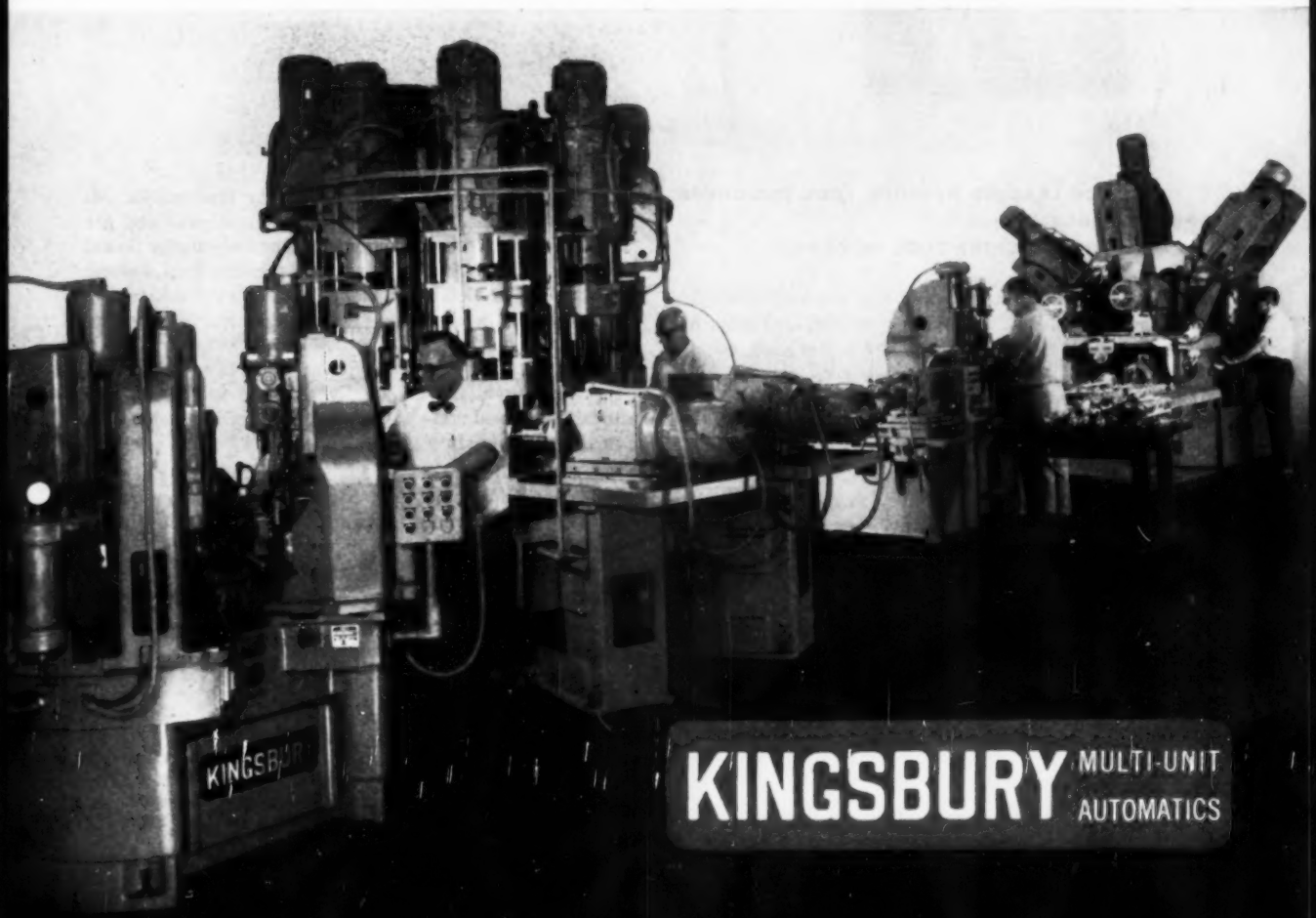
For more operations or larger parts than the regular indexing machines can handle. 8 to 14 stations. 43- or 63- inch index table. Horizontal units mounted on knees. Easy access to tools.

NON-INDEX (WAY TYPE)

For operations from 2 or more directions on one part at the same time. When a job needs successive operations, two or more of these machines may make the most efficient setup.

VERTICAL INDEXING

For successive operations from opposed directions with up to 5 horizontal units on each side of the machine. Up to 4 radial units provide a third direction. 8 stations in a vertical plane.



WHY DO LEADING MACHINE TOOL DESIGNERS SPECIFY REULAND PRECISION **MACHINE TOOL MOTORS?**

The answer is that these men *know* Reuland Precision Machine Tool Motors are made specially, and only, for machine tool use. Not just another motor that can be "adapted to fit," but a completely new concept that finally achieves the vibrationless operating characteristics so vital to precision machine tool operation.

Dynamic Balancing at our factory tunes every motor to the jewel-like perfection of a fine watch. *Bearings On Each Side Of Rotor* hold it solidly in dynamic position ...lock this true balance in forever once it is achieved. *Radial Air Gap Design* permits the use of a light, narrow, low inertia rotor which, in turn, assures smooth starts and quick stops. The motor's overall length is also reduced to give it a thinner "wafer" effect. *Fin-Type Cast Aluminum Alloy Frames* dissipate heat approximately three times faster than cast iron. *Smooth Castings and Pleasing Lines* are the exterior quality trademarks. All surfaces are specially processed for smoothness and are given a fine, baked enamel finish. This fine-quality finish, together with the motor's naturally pleasing lines, assures a harmonious blend with the lines of every machine tool on which it is mounted. (When desired, the motor's frame size can be varied to fit an *exact* contour of your machine.) *All Heavy Duty Ratings*... ½ h.p. through 10 h.p....are available in totally enclosed fan-cooled and totally enclosed non-ventilated types...either continuous or intermittent duty.

SEE WHAT REULAND CAN DO FOR YOU...by *actually testing* a Reuland Machine Tool Motor on your machine. So sure are we that you will like what you see, we are offering to engineer a demonstration unit to your equipment without the slightest obligation. Just write us.

Our new 8-page brochure "MODERN POWER FOR MODERN-DAY PRODUCTS" will be helpful in your work. Sent free on request.

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
Western Division: Alhambra, Calif.
Eastern Division: Howell, Michigan
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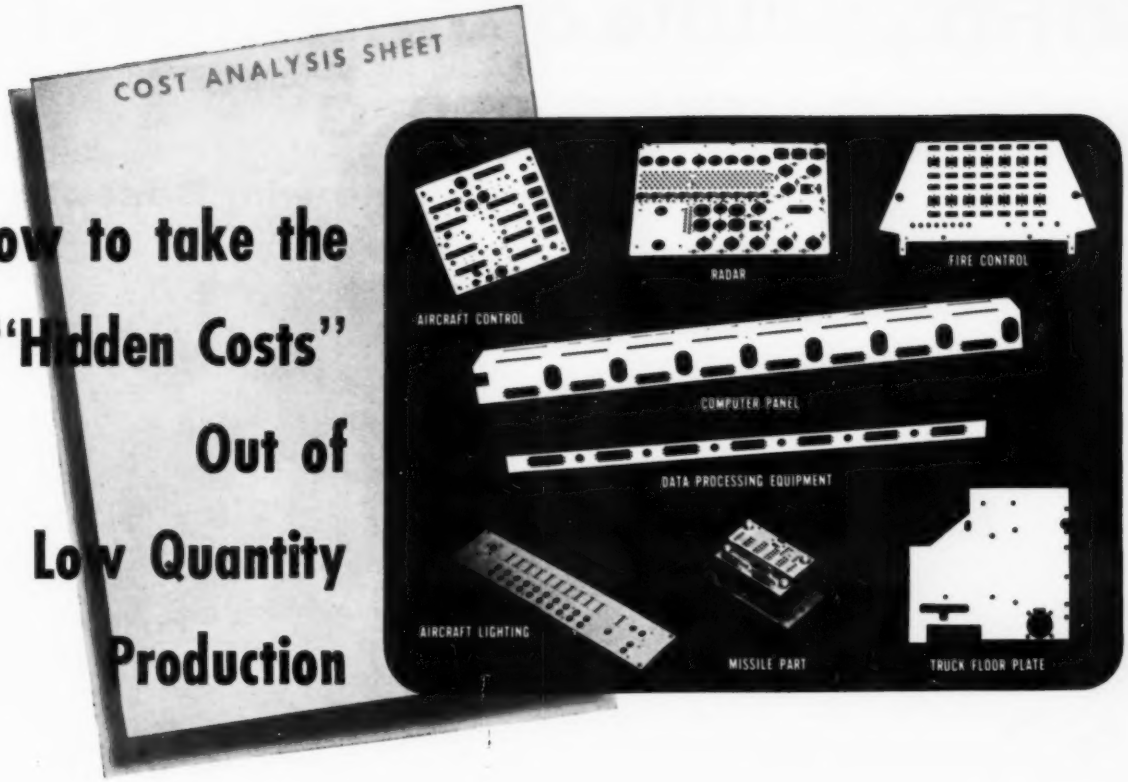
how to take the "Hidden Costs" Out of Low Quantity Production

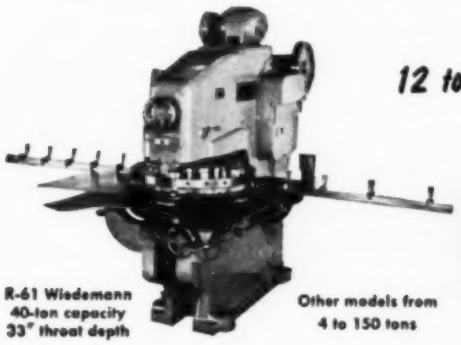


Multiple handlings . . . special die sets . . . multiple tool setups . . . hand layout . . . burning . . . nibbling . . . drilling . . . deburring . . . excess inventory, etc.

These and many other "hidden costs" in sheet metal fabrication are eliminated by Wiedemann Turret Punch Presses. Parts are produced as needed on a press specifically designed for producing a wide variety of jobs in quantities ranging from one to several hundred of a kind.

All tools normally required are in the turrets ready for use. Work is accurately positioned by a quick-setting mechanical gauge. Even extensive engineering changes can be made on-the-spot at low cost. Direct savings of 60% to 90% pay for the press in two years or less.

Find out how you can eliminate your "hidden costs" with the Wiedemann Method. Send drawings of your work for time study and write for Bulletin 301 today.



R-61 Wiedemann 40-ton capacity 33" throat depth

Other models from 4 to 150 tons

12 to 32 Punches and Dies Ready for Use

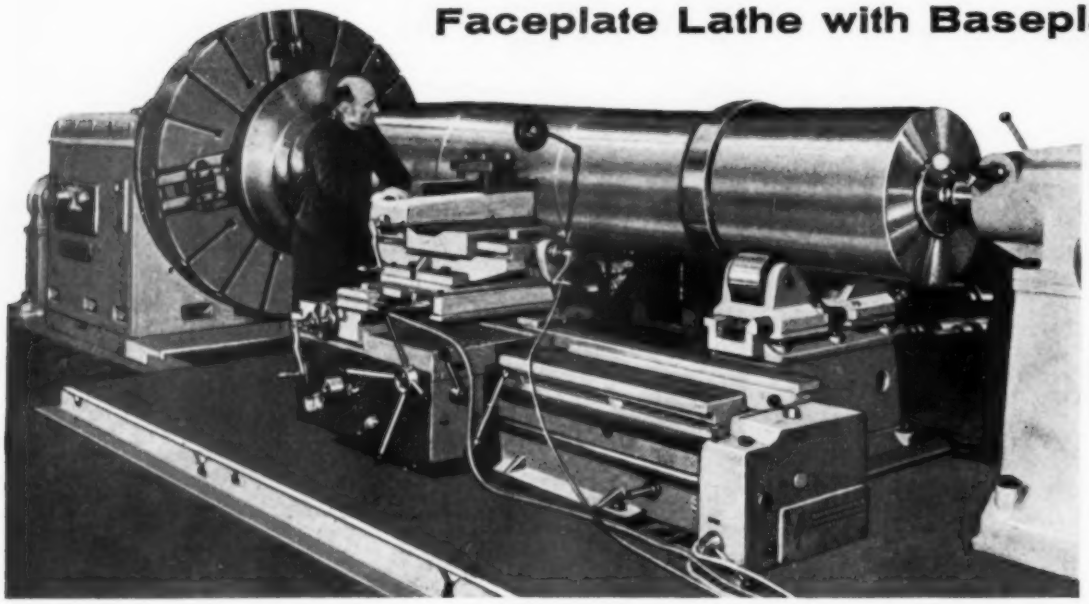
WIEDEMANN MACHINE COMPANY
TURRET PUNCH PRESSES

DEPT. AM-8 • GULPH ROAD • KING OF PRUSSIA, PA.

Unparalleled Versatility!

RAVENSBURG

Faceplate Lathe with Baseplate



Ravensburg Faceplate Lathe showing headstock, tailstock, steady rest, carriage and baseplate in working position. Note "Electric-Shaft" Drive (arrow).

The headstock and bed of Ravensburg Faceplate Lathes are separate units, with the tailstock traveling on special baseplate slideways. The bed can be positioned on the baseplate either perpendicular or parallel to the turning axis, or at any intermediate location. This ultra-versatility is especially valuable in machining large, relatively light workpieces; such as missile bodies or nose cones, and medium weight workpieces for generators and turbines.

The headstock has 12 to 18 spindle speeds. It can be equipped with a mechanical or electrical variator drive and constant cutting speed control.

Accurate feeding of the carriage, in inches per revolution, is obtained through a patented "electric-shaft" drive, which eliminates any mechanical linkage with the headstock, and permits independent positioning of the bed on the baseplate. The cross slide carries an upper slide which is mounted on a rotary base and feeds automatically in any direction.

Electric or hydraulic copying devices are available to meet specific requirements.

SPECIFICATIONS

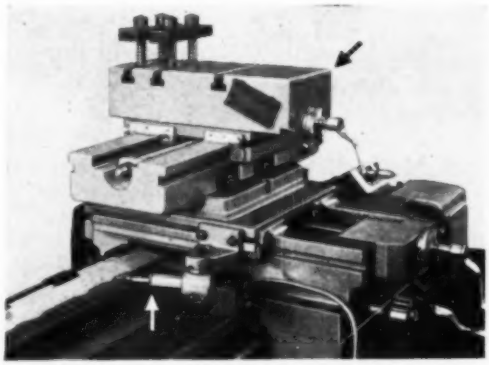
Center Distance—virtually unlimited!

Swing over Baseplate—110″

Max. Faceplate Diameter—138″

Five standard models—
many combinations from which to choose.

Special designs available upon request.



Upper slides of carriage showing electric copying device (arrow). Rotary base (arrow) and manually controlled tool slide.

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COSA — *nationwide sales and service of precision machine tools—from bench lathes to boring mills.*

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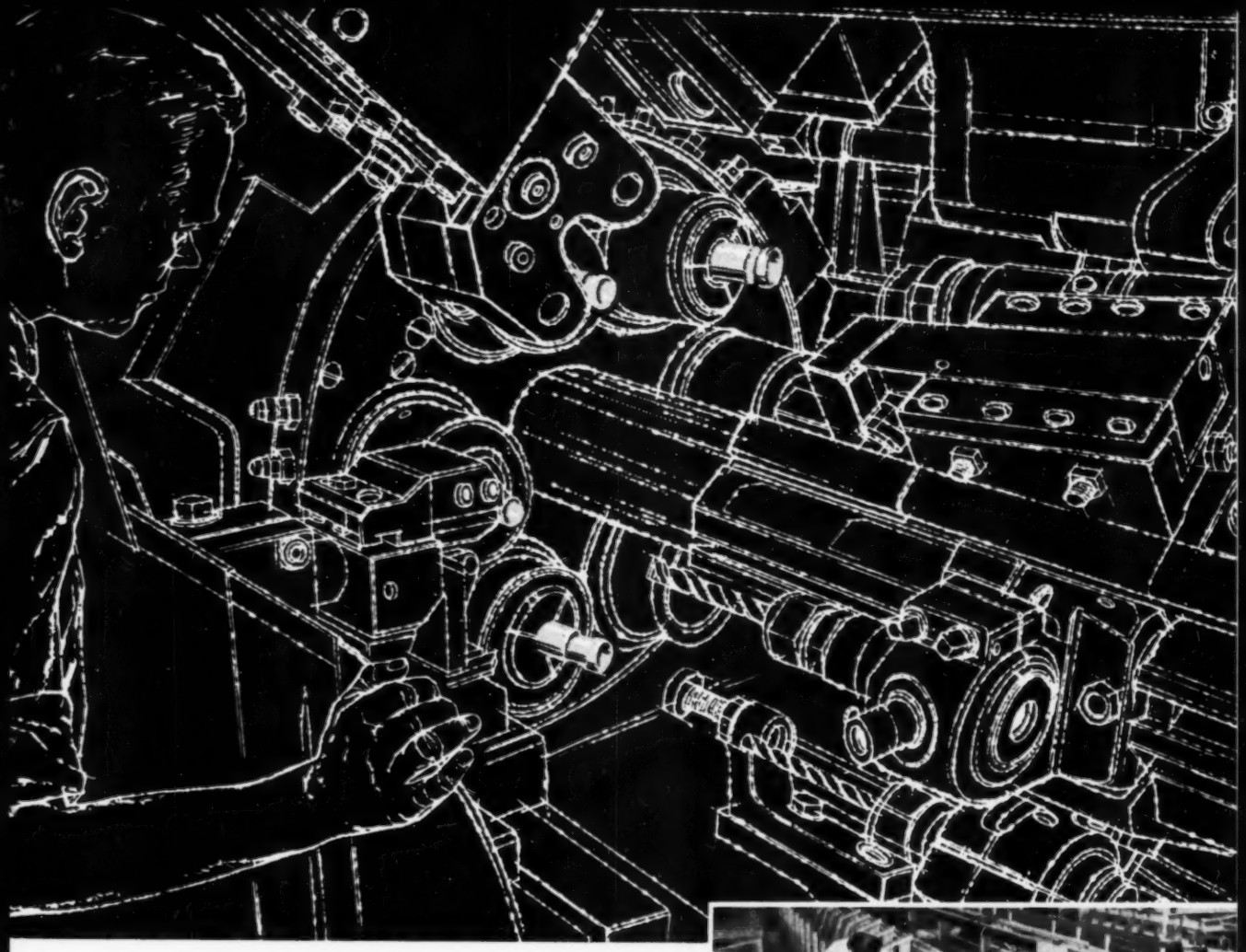

The Ultimate Test

The ultimate test of quality in stainless steel bars takes place in screw machine production, where every bar is literally cut to pieces.

The Perry-Fay Company, Elyria, Ohio, a leader in screw machine production, has been subjecting J&L bars to this demanding production-line test for more than a year, **without a single failure, without a single reject.** Perry-Fay reports: "We consistently get superior surface finish, closer tolerances, fully formed rolled threads with J&L stainless bars."

Whether you need stainless steel bar stock for high-speed, high-production operations, or a single bar for extraordinary requirements, turn to J&L. J&L leads the industry in melt shop standards for stainless steel, the point where quality starts—and new production profits begin.

Careful attention to every production detail is the key to J&L quality.

J&L
STAINLESS
SHEET • STRIP • BAR • WIRE

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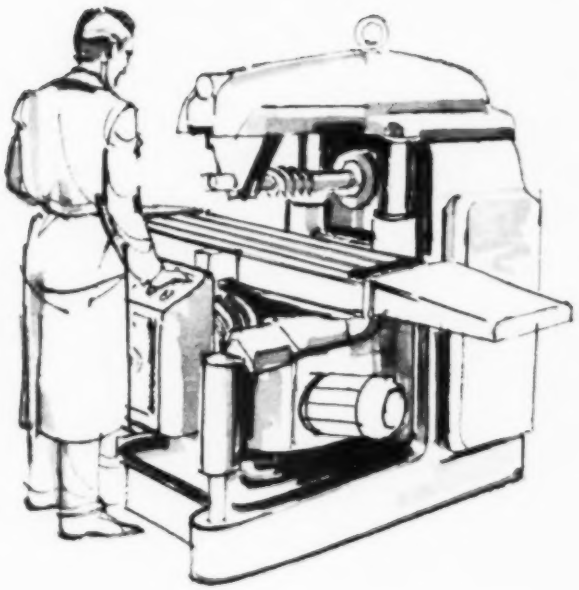
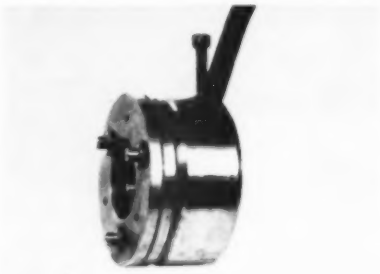
STEP UP MACHINE TOOL PRODUCTIVITY

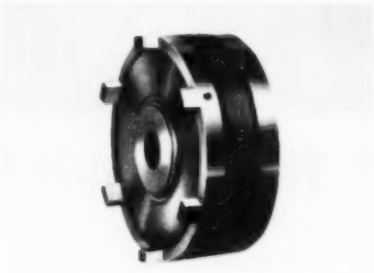


I-T-E Electro-Clutches permit instant speed or feed changes without stopping the machine or manually changing gears, chains, cams or belts. More compact than any similar clutches, they fit right in transmission boxes . . . operate under oily conditions. Clutching action is instantaneous . . . entirely electrically actuated. Sizes and types to cover practically every application from 1.8 through 13,000 lb.-ft. Send for catalog. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.

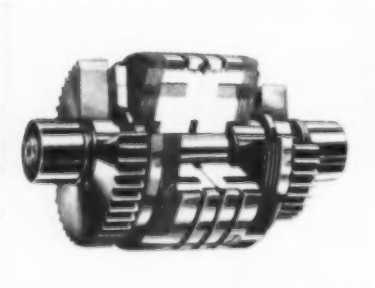
S SERIES. Stationary field, external drive, unit assembly. No brushes.



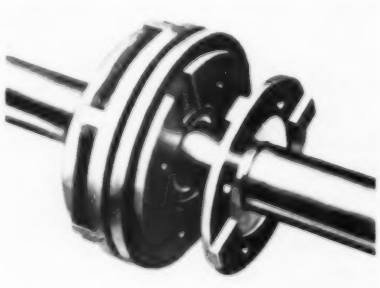
SF SERIES. Stationary field. Serrated face tooth.



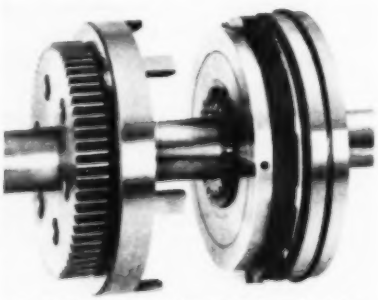
F SERIES. Serrated face tooth. Provides high torque in small space.



STANDARD. Internal drive. Magnet body rotates with shaft.



B SERIES. Magnet body rotates with shaft. Usually used as a brake.



C SERIES. External drive permits unit assembly. Facilitates machine assembly.

I-T-E CIRCUIT BREAKER COMPANY

courtesy Linden Tool and Manufacturing Co.

Linden's Gilbert holds 235 holes on location ±.0007″

This is the kind of job you can handle profitably if you have a good operator and a Cincinnati Gilbert horizontal boring mill.

The piece is a 50″ by 120″ base for special indexing. Linden Tool and Manufacturing Co., Dayton, O., performs these operations:

1. Mill keyways $^{9}/_{32}$″ deep, full length and width of the base. Width of each keyway is 1.000″ ± .001″.

2. Drill 235 indexing holes, .625″ diameter. These holes must be held on location within ± .0007″. In addition, center lines of the holes (horizontal and vertical) must be parallel and square with the key-ways within .001″.

This job is another demonstration of the exceptional rigidity of Gilbert boring mills. Extended table and saddle supports help to maintain accuracy and handle the workpiece. Linden Tool and Manufacturing Company uses two Gilberts to produce a broad range of quality work for its Dayton area customers.

Gilbert boring mills are built as both Table and Floor types, with spindle diameters of 3½″, 3¾″, 4″, and 5″. A selection of column heights, bed lengths, table sizes, and workholding units makes them easily adaptable to your requirements. Add to your work capacity—and your machining dollars—by getting a proposal from Gilbert now.

The Cincinnati Gilbert Machine Tool Co.
***3340** Beekman Street, Cincinnati 23, Ohio*

those who buy Gilbert buy **GILBERT** *again*

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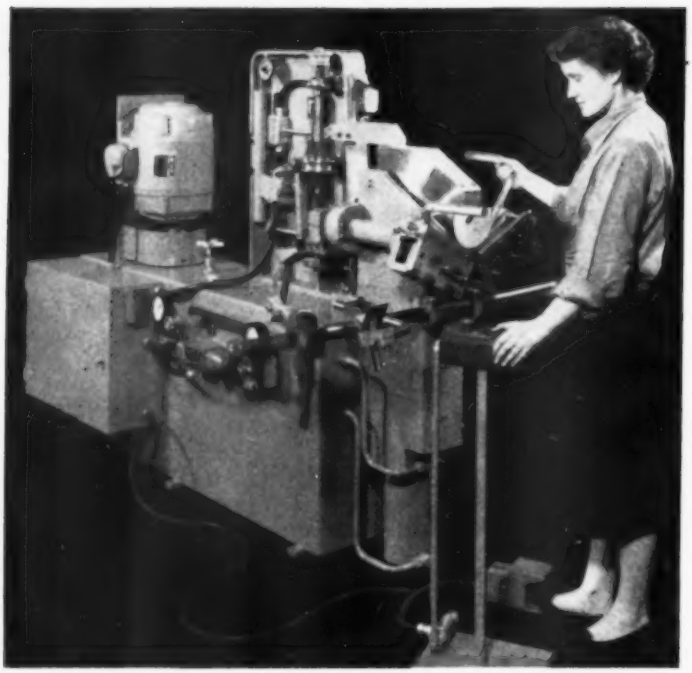
NEW PINES 3T PRESS

Cuts Bending Costs AS MUCH AS 50%



Makes Bends Progressively to Varied Angles In Multiple Planes 2 to 3 Times Faster

Quality bends at production speeds that are 2 to 3 times faster than conventional methods, are now possible with the new Pines 3-T Bending Press. Many tubular parts in sizes up to 1" O.D. are now formed at net speeds of over 1000 bends an hour. Up to 9 different bend angles can be produced in a single setup. Adjustable automatic indexing stops accurately control depth of ram stroke. Open tooling area permits rapid progressive bending in varied planes.

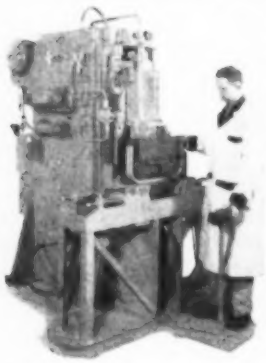
Wing Die Design Assures Quality Bends

High production speed is just part of the story. Unusually smooth, good looking bends are produced to meet the quality demands of automotive, furniture, toy, office equipment, and appliance manufacturers. Wing dies of the press are designed to move in ways as a bend is made, and their pivoting action is hydraulically cushioned through bearing-mounted rocker arms. This principle eliminates scratches or draw marks and produces wrinkle-free bends with very little distortion. Get the complete story on cost cutting advantages of this new Bending Press today.

COMPLETE LINE OF BENDING PRESSES

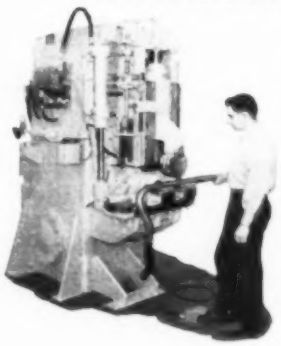
In addition to the Model 3-T, Pines also builds the larger bending presses, illustrated below, which are also establishing outstanding performance records.

MODEL 6T FOR MULTIPLE U-FRAME BENDING



Makes two bends of the same or slightly different angles in each of two or more tubes simultaneously. Production of four or more bends with each stroke makes it possible to form 1700 to 3000 bends per hour in tube sizes ranging up to 1" O.D. x .065". When necessary, retractable ram dies are used to release pieces from die grooves. Like 3-T, wing dies move with work, eliminating draw marks, producing bends of superior quality.

MODEL 1900 FOR PROGRESSIVE BENDING OF TUBES UP TO 2" O.D.



Designed for high speed bending of parts requiring a variety of bends in different planes, such as automotive exhaust and tail-pipes, or similar work. Major features are automatic angle indexing and greater working clearance which permits completing, for example, 90% of all bends in a tail-pipe with a single tooling setup. Press handles stock sizes up to 2" O.D.

PINES ENGINEERING CO., INC.

Specialists in Tube Fabricating Machinery

671 WALNUT • AURORA, ILLINOIS

WRITE FOR *FREE* DATA SHEETS

To keep abreast with bending, write for free copies of "Pines News"—get latest data on rotary and press-type machines, and up to date information on tooling.

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY

FIELD PROVEN...

Honeywell Electro Hydraulic Tracer Systems

Now operating on a wide variety of well-known machine tools (some of them illustrated at the right), Honeywell 180° and 360° Tracer Control systems provide fast, accurate and reliable system response for smooth application of large increments of hydraulic power.

They combine the flexibility, remote control and finesse of electronics with the power and fast actuation of hydraulics. They're far more flexible than completely hydraulic systems. These systems have been designed for ease of application. Modular construction simplifies and speeds field service.

Accuracy—Accuracies of ± .0005" from template to part and ± .0002 from part to part have been achieved in actual use.

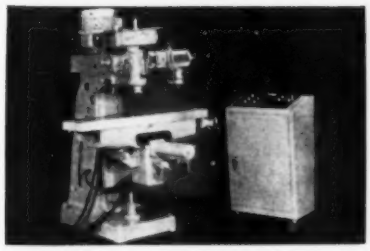
Adaptability—These systems are now in operation on all types of machine tools, from light duty engine lathes to huge spin forging machines. Every application is custom fitted—at production line prices.

Performance—Each Honeywell system becomes an integral part of the machine tool. The control system can be adjusted to compensate for changes in machine performance during the life of the machine. Speed range of 300 to 1 is normal; greater rangeability is available on some applications. Tracing speed ranges up to 60" per minute are available.

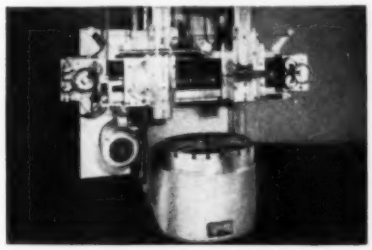
For further information on Honeywell's new machine control systems and components and their application to your specific job, contact Minneapolis-Honeywell, Machine Control Group, Dept. AM-8-93, Minneapolis 8, Minnesota.

Honeywell

H HONEYWELL First in Control



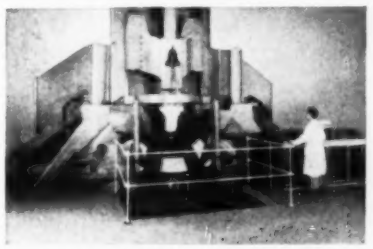
Gorton Vertical Milling Machine equipped with Honeywell 360° Electro Hydraulic Tracer Control System.



Giddings & Lewis vertical turret lathe with Honeywell 360° Electro Hydraulic Tracer Control System.

Frauenthal Division of Kaydon Engineering Corporation turning and grinding machine with Honeywell 180° Electro Hydraulic Tracer Control System.

Rockford Machine Tool Company hydraulic mill with Honeywell 180° Electro Hydraulic Tracer Control System. Swarfing operation.



Hufford Corporation spin forge machine with *two* Honeywell 360° Tracer Control Systems plus spindle speed control.

CIRCLE 301 READER SERVICE CARD

3 short steps to longer tool life with the

Brush Surfindicator

The Brush Surfindicator can increase your tool life *up to 50%* by setting microinch specifications on

(1) The *cutting edge* of the tool for optimum cutting efficiency.

(2) The stock surface to arrive at the most efficient cutting *angle* of the tool.

(3) The surface finish to determine exact *point* in the production run at which to *replace* the tool.

Your production runs can be lengthened—machine shutdowns and rejects reduced—your quality maintained with the Brush Surfindicator.

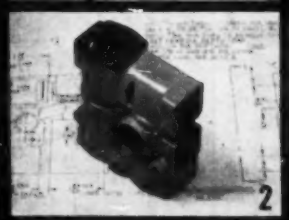
A demonstration can be arranged in your plant. Call us—set a date—we'll be there!

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

EDLUND

The Greatest Advance in Drilling and Tapping Machine in the Past 25 Years

1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3

4

Some of the many precision parts drilled and tapped with EDLUND Model 2F machines at Aro Equipment Corporation:

1. AIR TOOL HOUSING—8 drilling operations, 2 tapped holes #32 7/16".
2. AUTO VALVE BODY—15 holes, 10-32, Class 3 threads.
3. BRASS PUMP BLOCK—30 drilling, reaming and tapping operations.
4. VALVE BODY—16 spindle operation, 1/8"-3/8" holes, and 12 counterbores.

SPECIAL MACHINES • EDLUND'S years of experience at your request to design special application machines.

PRODUCTION INCREASED
QUALITY IMPROVED
COSTS REDUCED

ARO EQUIPMENT CORPORATION

Bryan, Ohio Plant

Production line of EDLUND Model 2F Infinitely Variable Speed Drilling and Tapping machines turns out drilled and tapped parts faster, with better quality and at lower cost.

These powerful EDLUND machines give constant service with minimum downtime and feature flexibility to handle a wide variety of drilling, reaming, chamfering, counterboring, and tapping operations.

There is an **EDLUND** for your drilling and tapping jobs:

Model 1F
3/8" Capacity
Spindle speeds to 10,000 rpm.
Bulletin 160

Model 2F
1 1/4" Capacity
Spindle speeds to 3600 rpm.
Bulletin 140R

Model 2G Gun Drilling
5/8" Capacity
Spindle speeds to 8000 rpm.
Bulletin 2G

Model 4F
1 3/4" Capacity
Spindle speeds to 2200 rpm.
Bulletin 170R

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MACHINERY COMPANY

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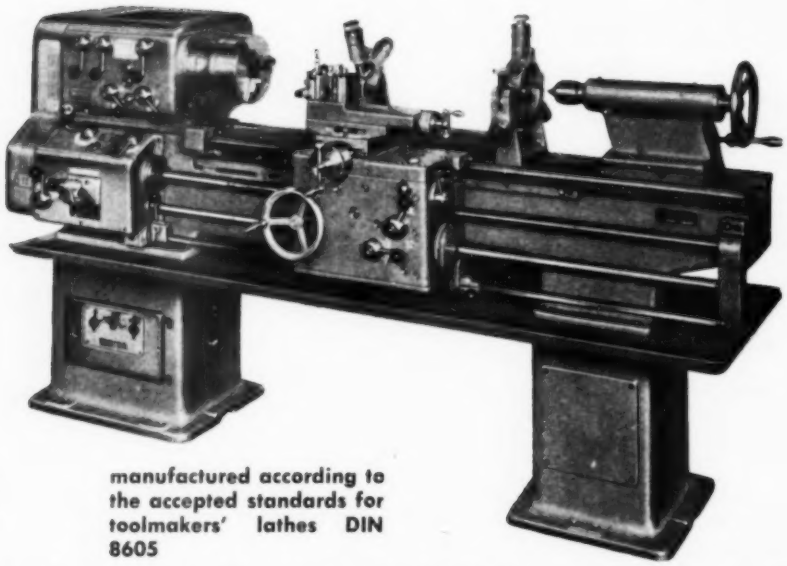
MATRA

Precision High Speed Lathe Type D 10

with headscrew and feed rod

reliable ▶
efficient ▶
low cost ▶



Height of centers 180 and 200 mm
Distance between centers, 1000, 1500 and 2000 mm

manufactured according to the accepted standards for toolmakers' lathes DIN 8605

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Do you get more holes per minute • longer drill life • closer tolerance holes • less operator fatigue?

Equal size chips mean you are getting these results from your drills.

Hand sharpened drills should produce equal size chips . . . but only after time-consuming work by an expert. Now, with the Black Diamond Drill Grinder*, anyone in your plant can do the job with repeat accuracy in just a few seconds. Get the facts by return mail. Write exclusive distributor:

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BLACK DIAMOND DRILL GRINDERS: For #70 drills up to ⅜ (Illus.)

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*Black Diamond Saw & Machine Works, Inc.
Natick, Mass.—Manufacturers of Black Diamond and Worcester Drill Grinders.

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COUNTERSINKING WITH CARBIDE

—Steel, titanium, abrasive non-ferrous materials, including fibre glass panels, heat-treated steels, long runs of any material?

HERE'S HOW YOU SAVE WITH

CRAIG THREADED-SHANK

CARBIDE TIPPED COUNTERSINKS!

Consider the original cost of carbide cutter, *plus* fewer resharpenings per run, *plus* fewer cutter changeovers, *plus* more burr-free holes...

divided by the total number of parts...

equals the lowest cost per hole—the only cost you care about!

Reverse Spotfacers

Reverse Countersinks

The same profit formula works with Craig Reverse Countersinks and Spotfacers, too! Write for catalog and prices.

CRAIG TOOLS, INC.

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CIRCLE 306 READER SERVICE CARD

CIRCLE 307 READER SERVICE CARD ▶

PHOTO BY KARSH OF OTTAWA

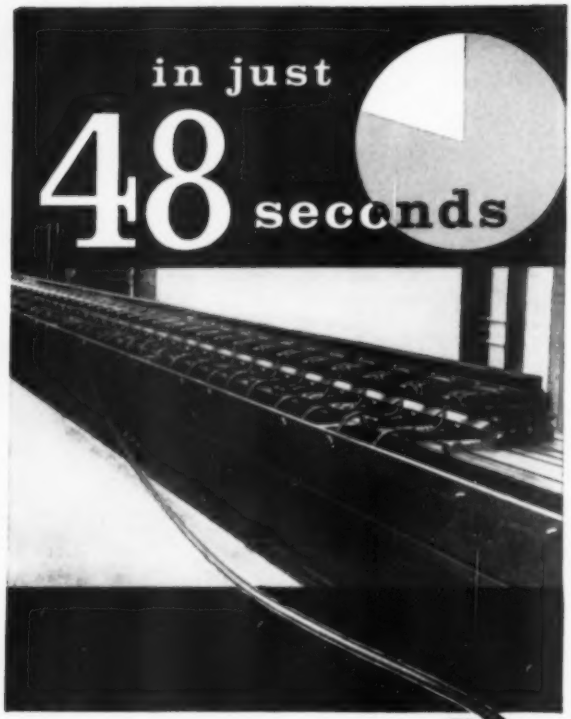
"We can depend on Sharon for steel of consistent quality"

—CHARLES MacINTOSH, Supt. of Assembly, Smith-Erie Div., A. O. Smith Corp.

"We've found Sharon Steel meets specs—then holds to them," says Charles MacIntosh, Superintendent of Assembly at A. O. Smith's Erie Division. "That's probably the most important single consideration to those of us responsible for fabrication," MacIntosh continues.

Shown here with Harold L. Ripley, Supt. of Machine Shop, MacIntosh examines a stainless steel stamping—a part for A. O. Smith's new line of ultra-modern gasoline pumps. He concludes, "For finish, too, it's hard to beat stainless from the *Sharon Steel Corporation, Sharon, Pa.*"

SHARONSTEEL **SHARON** *Quality* **STEEL**

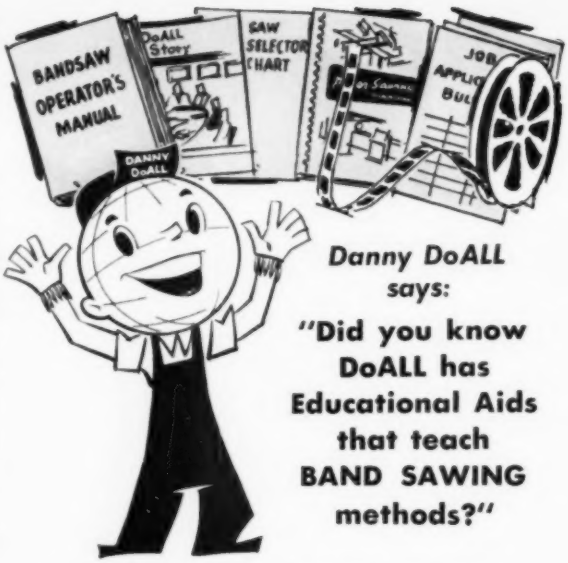


THIS HAND clamps 96 cylinders from one source

It's a fact! This hand, with one pump activates 96 clamps simultaneously. The Newton Hydraulic Clamping System of pumps, cylinders and mounting parts provides ease of application . . . Cuts production time . . . And is moderate in cost.

Learn more about this universal clamping system. See your Newton distributor now or write for free catalogue, with full scale templates provided.

NEWTON NEWTON HYDRAULIC TOOLING COMPANY
AUBURN, MASSACHUSETTS, U.S.A.



Danny DoALL says:

"Did you know DoALL has Educational Aids that teach BAND SAWING methods?"

Textbooks! Training manuals! Tool selector wall charts! Job-spotting bulletin service! Educational movies and many other informative aids are furnished *free!* Call your local DoALL store.

SB-75¼

THE DoALL COMPANY
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A SPECIALIZED CAM MILLING SERVICE
Over 100 Types of INDEXING TURNTABLES
Also Geneva Gears, Spot and Butt Welding, Positioners for Brazing, Spraying, Welding and Soldering
CAMS OF ALL TYPES
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This style instrument can be furnished with various dials, graduations and ranges, in both English and Metric. There is an R. & S. Gauge for practically every purpose. Write for circulars describing our complete line.

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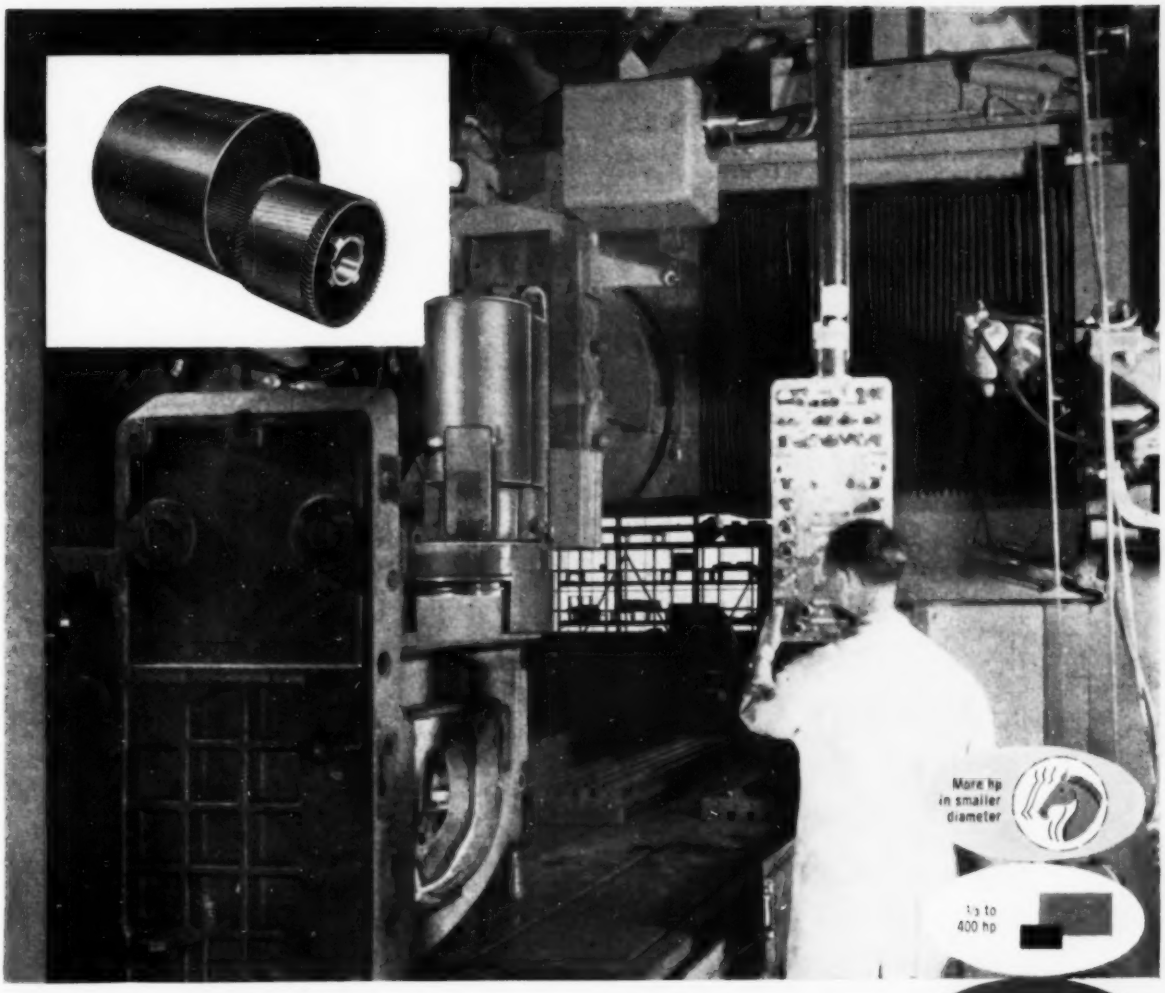
Makers of Dial Gages Since 1898



This motor can be built-in!

Louis Allis rolled-shell shaftless motors provide compact, close-coupled power for machine tools

Here's just one of many Louis Allis special motor designs that machine tool builders respect and users appreciate. It's a 30 hp, 1200 rpm rolled-shell shaftless motor — pioneered by Louis Allis.

The motor consists of a precision stator in a steel shell and an accurately machined rotor that can be mounted directly on machine tools like the rotary surface grinder shown above.

The compact motor allows closer spacing of spindles and shafts. It reduces the weight and size of the machine — blends the motor into the machine contour. Its design flexibility enables you to use direct drives for separate machine functions — to select motor characteristics best suited for each operation.

Louis Allis rolled-shell shaftless motors range in size from ⅓ to 400 hp. They can be furnished with high torques, low losses for grinder duty, vibration-free operation, and other special modifications. For more information — for engineering assistance — call your Louis Allis District Office. Or write The Louis Allis Co., 452 E. Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

SM-107

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

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Designed specifically for small precision jig boring. Accurate to a high degree—simplified design enables fast, precise set up and operation. An extremely versatile machine that can save you money by releasing larger capacity borers for heavier work. Write for complete information on these improved Linley Jig Borers. Table size — 7" x 17½"; table travel — 6½" x 10".

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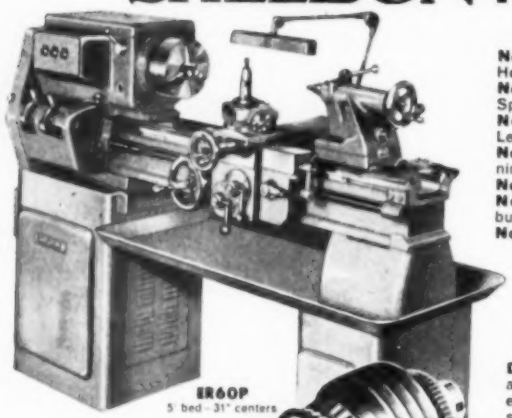

ER60P
5' bed - 31" centers

NEW

New. Revolutionary double-box Headstock (Pat. Pend.)
New. "WORK-HOLDING ONLY" Spindle.
New. Single-Shift Back Gear Lever on Headstock.
New. Headstock and Apron running in oil.
New. 1⅛" Hole through Spindle.
New. 60-pitch Gear Box with built-in Lead Screw Reverse.
New. Amazing LOW PRICE.

DIFFERENT

Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.
Different. Electrical switches and push-button stations fully enclosed in built-in well in headstock.
Different. Two independent clutches in apron for selecting power feeds.
Different. Cam-action tailstock clamp for rapid release and instant locking of tailstock.
Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

$2591.00 base price F.O.B. Factory (Less Electricals)

This is an all new lathe that bridges the gap between conventional belt driven and geared head lathes. It combines the capacity and power of a geared head with the economy and flexibility of a belt driven lathe. Available with 5', 6' and 8' bed lengths providing 31", 42" and 66" center distances.

Send in Coupon for full information

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Gentlemen: Please send me information on items checked.

- ☐ The NEW and DIFFERENT SHELDON 15" Lathes
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Miniature END MILLS

Woodruff & Stokes now offers end mills in a variety of sizes up to 0.125-inch maximum. All end mills are two-flute, right-hand spiral, and will be ground to any desired diameter. These tools are made of M-2 type high speed steel. Perfect concentricity is maintained between shank and cutting diameters. The diameter of the cutting end can be held to a tolerance of ±.0001. Delivery approximately 2 to 4 days.

For complete information on the special tool design services of Woodruff & Stokes, write to:

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PRODUCTION METHODS at GRAFLEX

Here are details of unique precision production methods at Graflex, Inc., Rochester. An *American Machinist* Special Report. 20 pages, illustrated, 25 cents a copy.

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We make so many sizes... your "specials" could be our "standards"

Angular Contact Bearing

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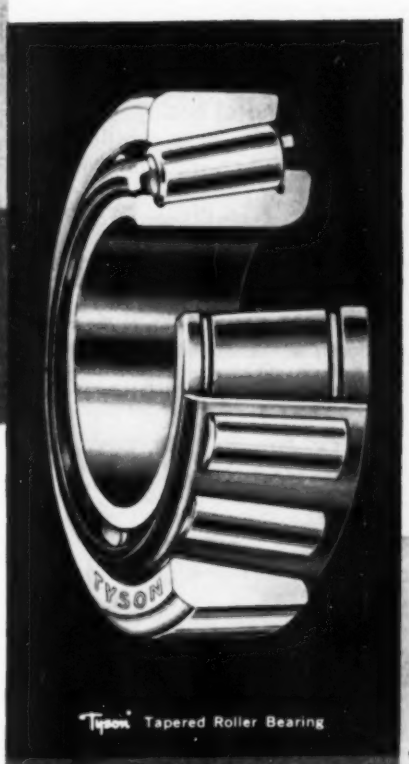

Tyson Tapered Roller Bearing

Single-Row Deep Groove Bearing

Cylindrical Roller Bearing

We regularly produce all of the bearings shown here in a tremendous variety of bores, outside diameters, and widths.

Take just the Tyson tapered roller bearing, for example. We make nearly 1,000 sizes of the single-row, straight bore type alone! Bore sizes range from five-eighths of an inch right up to a precise fourteen inches. And these figures don't include the many other sizes available in our double- and four-row types.

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So, why not get full details on the most complete line in the business? Any of our twenty-five sales offices can quote you facts and figures. Just call the one near you.

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Spherical, Cylindrical, Ball, and Tyson Tapered Roller Bearings

EVERY TYPE—EVERY USE

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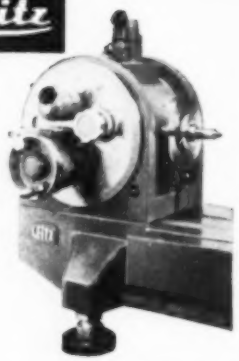
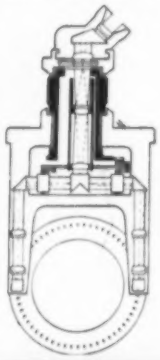
ULTRA PRECISION IN SPACING

Leitz

Ultra Precision Spacing on guided missile components and similar critical work guaranteed by this exclusive DOUBLE - MICROSCOPIC PICK-UP of the LEITZ OPTICAL MASTER DIVIDING HEAD.





It compensates for runout, the most common source of error. Working accuracy 1 second of arc.

There is no substitute for LEITZ in optical dividing.

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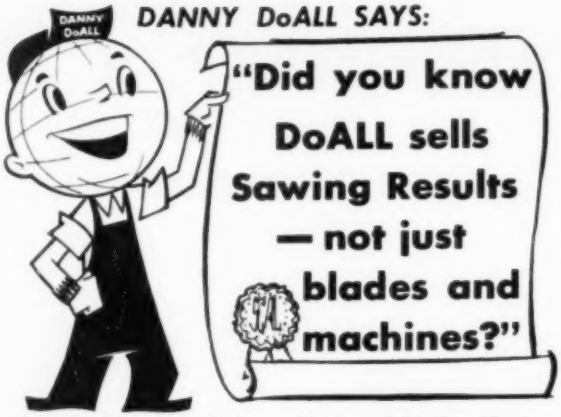
DANNY DoALL SAYS:



Only DoALL makes both machines and blades. That's why your DoALL Sawing Specialist knows best how to make them work together as a perfect team to give you top efficiency in your band sawing.

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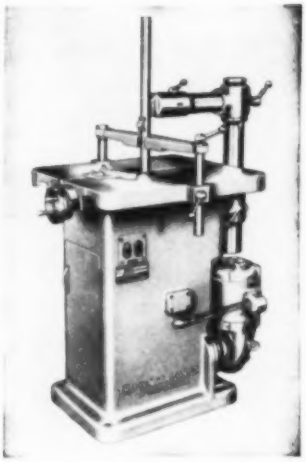
This new MORRISON KEYSEATER can make money for you



Install it in your shop. Its low cost will amaze you. Watch it pay for itself. You can quickly eliminate costly production tie-ups caused by waiting for expensive outside services. This is not an ordinary keyseater. The Morrison Keyseater is quality built with machine tool accuracy. Practically anyone can operate it. It has automatic feed, automatic stop to cut off feed at given depths, automatic relief to back the work away from cutters, automatic centering, automatic lubrication. NO BUSHINGS REQUIRED. Cuts keyways 1/16" to 1".

THE D. C. MORRISON CO., P. O. BOX 1017E, Cincinnati 1, Ohio
Please send Free "Keyseater" Catalog, showing specifications.

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Silent, Smooth SATISFACTION!

Scheduled for use in a Vertical Quintaplex Hydraulic Pump is this 680 pound rawhide pinion—21.6" O.D., 17" F., 5½" B., with bronze-flanged cast-iron center, 25 T., 1¼ D.P., and 3 pound rawhide pinion—3.666" O.D., 3" F., bronze bound; together with bakelite pinions and Fibroil bevel blanks. Quiet operation is enhanced by money-saving stamina. Be certain of flawless gear performance—contact Stahl first.

SPURS TO 72" PD. 1 DP
BEVELS TO 54" PD. 1 DP
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RACKS TO 20 FT. LONG. 3 DP
SILENT GEARS, RAWHIDE BAKELITE FIBROIL
HEAT TREATED CASE OR FLAME HARDENED GEARS—OF CARBON OR ALLOY STEEL

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What's more important to you

QDP or PDQ?*

Whirlpool Corporation reports: among 598,265 components supplied by Amplex the first 4 months of 1959, there were only 5 rejects!

Quality, Delivery, Price...
this Amplex philosophy enables our customers to cut their production and warranty costs.

The "Price" vendor with poor quality will increase your costs.

Amplex prices are low but cost-saving quality always comes first. A quality record of 99.999992% is the reason why Whirlpool Corporation says, "Quality is our business, too. That's why we purchase components from Amplex."

Contact your local Oilite® representative today. Reduce your costs with quality-controlled Oilite Precision Parts and Bearings. See "Bearings" in the Yellow Pages or write to Dept. I-8.

* *Quality-Delivery-Price vs. Price-Delivery-Quality*

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SINCE 1929 — A CHRYSLER PRODUCT — OILITE

the most trusted name in powder metallurgy!

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PRECISION PARTS • SELF-LUBRICATING BEARINGS • METAL FILTERS • FRICTION UNITS

Danny DoALL says:

"Do you know that DoALL's Sawing Research Laboratory will help you solve unusual band-sawing problems?"

SB-76¼

Find Your DoALL STORE in The "Yellow Pages"

Problem materials? Difficult cuts? High costs? Get the answers FREE! Call your local DoALL store.

THE DoALL COMPANY
DES PLAINES, ILLINOIS

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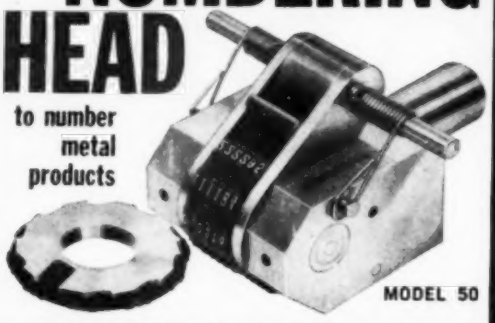
AUTOMATIC NUMBERING HEAD

to number metal products



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STURDY/ACCURATE/LONG LASTING

Rapid consecutive character wheels advance automatically after each stamping. Clear, uniform impressions. Wheel and index plate one piece unit, sturdier...greater uniformity. Index plate cannot become loose or out of alignment. Wheels available with Round Face characters for low-strain marking. Write for bulletin 50N.

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NEW WILSON

Pneumatic Die Grinders

for better, faster filing, grinding, cutting and polishing jobs

Model 913-41—
Air discharges at end of the tube in remote exhaust models

These small, powerful tools are valuable time savers on a wide range of work in tool and die shops, machine shops, pattern shops and foundries for a variety of filing, grinding, cutting and polishing work. Available in 40,000 and 60,000 rpm models. Write for Catalog PT-58.

Wilson also makes a wide range line of PNEUMATIC Horizontal Grinders

TW-884A

THOMAS C. WILSON, INC.
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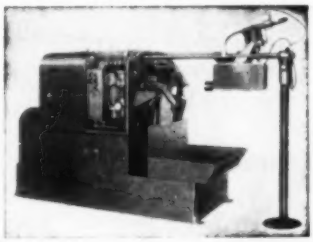
Tubing, Pipe and Bar Stock

The Modern Way

Automatic operation — from loading to final cut-off. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts any material that can be turned. 16 spindle speeds.



CATALOG

Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

108

WRITE

MODERN MACHINE TOOL CO.
2005 Losey, Jackson, Michigan

CIRCLE 326 READER SERVICE CARD

use Airco's new Dip Transfer† *CO_2 Process***

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low costs • easy fit up • high speed • very low spatter • no warpage

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- Penetrates deeply – critical for high quality.
- Welds much faster than flux-based processes.
- Uses money-saving Pureco CO_2 as shielding gas.
- The basic equipment welds all weldable metals.

The Airco Dip Transfer CO_2 Process gives you consistently *high quality* welds at *lower costs* than any other process. For complete information, phone or write your nearest Air Reduction Representative. Ask for the new 24-page "AIRCOMATIC CO_2 WELDING" Catalog.

Pureco CO_2 is supplied by the Pure Carbonic Company, a division of Air Reduction Company, Incorporated.
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Call your local DoALL STORE to learn how to improve your band sawing operations as much as 650% with greater accuracy, speed and finish . . . see demonstration!

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CIRCLE 330 READER SERVICE CARD

2746

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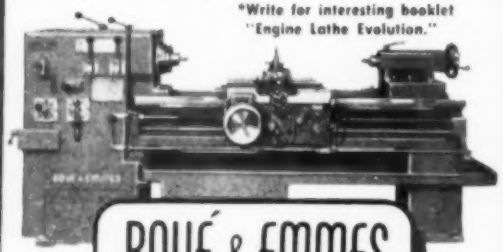

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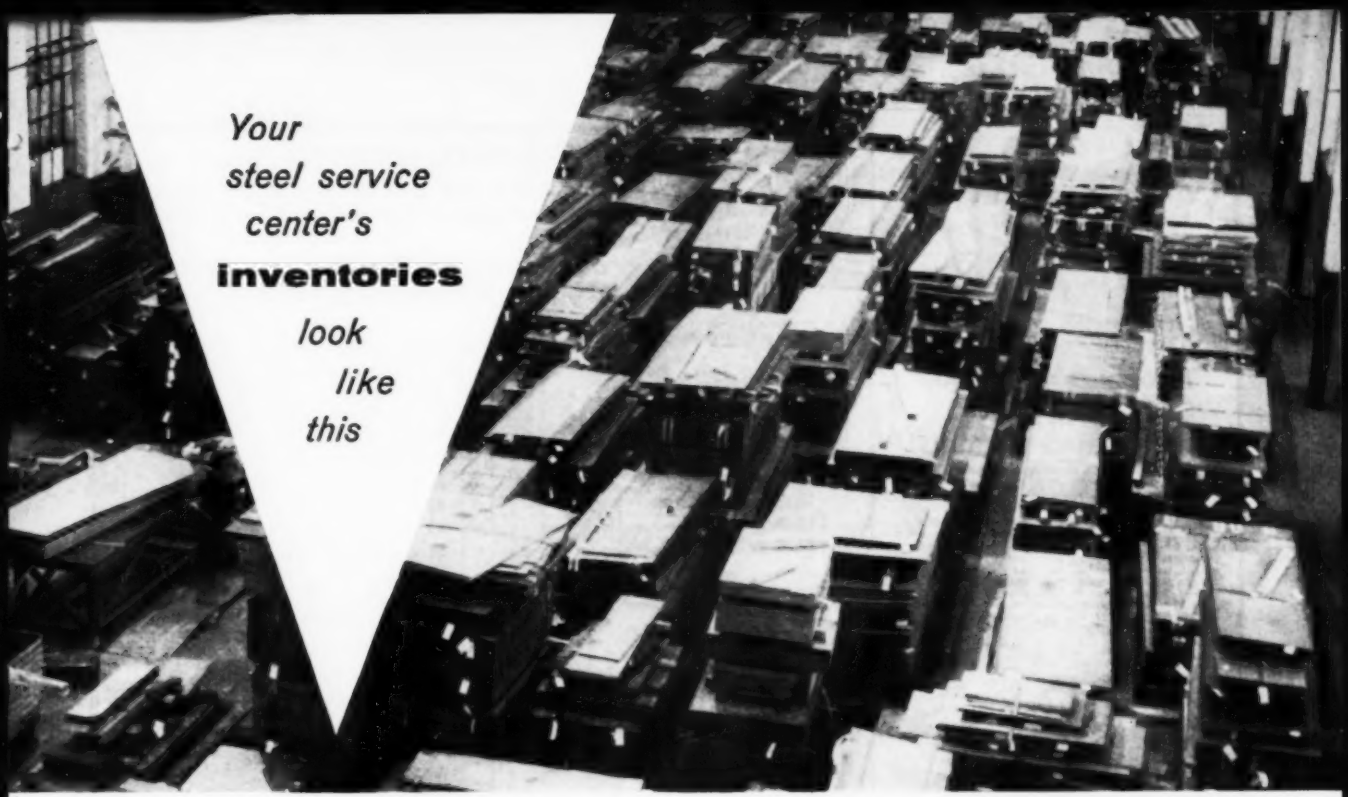
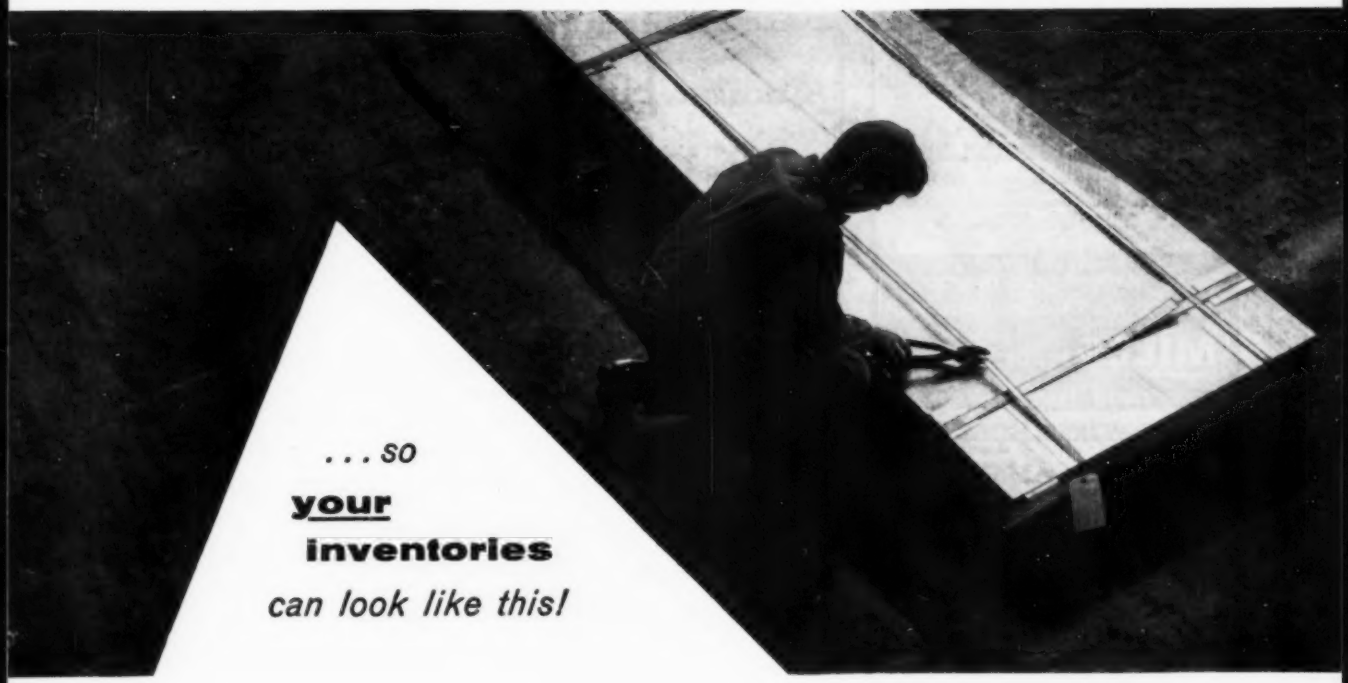


Photos courtesy of The Universal Steel Company



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Youngstown, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel

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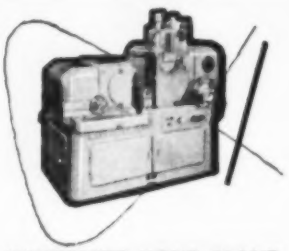

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This Landis No. 12 Centerless grinder is an example from our large stock of modern tools rebuilt by Miles to perform like new and ready for immediate shipment. Price $7500.

Automatic Cut-Off: 1½" 4 spindle cone, vert.
Auto.: 2" RB6 Acme-Gridley, 1944
Auto. Chucker: 6½" No. 665 New Britain, 1943
Balancer: Tinius Olsen prop. shaft, 1948
Borer: No. 47A Heald, tgl. end
Borer: DB1212A Ex-Cell-O, 1949
Boring Mill: 4" bar Universal table Timken
Broach: 10 ton 54" American vert. duplex
Centering: 6" x 72" No. 56 Sundstrand
Compressor: 650 CFM Sullivan duplex, 125 HP
Drill, Deep Hole: 420 W. F. & John Barnes, 1942
Drill, Multiple: No. 4BL Natco, 36 spdl.
Drill, Upright: 21" Cin. Bick. IL superservice late
Drill, Upright: 22" Barnes, late
Drill, Radial: 4'11" Carlton, 1941
Drill, Hydr.: No. 25 Ex-Cell-O, late
Gear Hobber: No. 3 Barber Colman, prec., late
Gear Shaver: 8" Red Ring, 1940
Grinder, C'less: No. 12 Landis, 1948
Grinder, C'less: No. 2 Cincinnati, Almatic
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 74 Heald, 1941
Grinder, Surf.: 12" x 36" Mattison, 1942
Grinder, T&C: No. 2 Cincinnati, 1944
Grinder, Univ.: 10x24 & 12x36 Landis, late
Lathe, Auto.: 8" x 13" Sundstrand
Lathe, Auto.: No. 8 Gisholt, 1950
Lathe: 10" x 54" American Pacemaker, 1941
Lathe, Engine: 24" x 120" Monarch Model CM, 1943
Lathe: 25" x 72" Axelson, 1944
Lathe, turret: 9½" Hole No. 4L Gisholt
Mills, Boring: 60" Gisholt, vert. QCG
Mills, Prd.: No. 33 Sundstrand Fluid-Screw, 1942
Mills, Prd.: No. 5-48 Cincinnati, late
Mill: No. 3H K&T, plain, 1943
Mill: No. 5H K&T, plain, vert. hd., 1941
Mill: No. 3M K&T vert., 1943
Mill: No. 36 VanNorman, ram, 1942
Mill: 42" x 42" x 10" Ingersoll planer type
Planer: 60" Rockford Hydr. open side, 1941
Press: 110 ton No. 675B Bliss, high speed
Press: 150 ton Lake Erie hydr., 1951
Press: 1200 ton Cleveland, coining, air clutch, 1943
Press: 350 ton Elmes, hydr., 1944
Saw: 10" x 10" Racine shear cut
Slotter: 36" Rockford Hydr., 1943
Upsetter: 4" National, air clutch, 1944

OVER 1,000 NEW AND USED MACHINE TOOLS IN STOCK
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Listed below are used, surplus new and rebuilt machine tools or services as advertised in this section.

The numbers after the advertiser's name, indicates the products or services offered by the advertiser.

2 Automatics
3 Balancing Machines
6 Boring Mills
7 Broaching Machines
10 Compressors
15 Drilling & Reaming Machines
22 Gear Cutting Machines
23 Grinding Machines
28 Lathes
32 Milling Machines
36 Planers
40 Presses
49 Services
58 Fork Lift Trucks

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Classified Advertising Division, P.O. Box 12, N. Y. 36, N. Y.

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8/10/59

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Horizontal Table Type
BORING MILLS!

2—#350T Giddings & Lewis 5"
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All with 2" 1500 RPM. Spdle.

1—4½" #26 DEFIANCE, with 800 RPM. Spindle
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135 tons, Bliss #6-48, Bed 48"x30"
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HIGH SPEED PRESSES
75 Ton Cap.—BRANDES
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No. 4BM Fosdick, single spindle, H.S., m.d.
No. 4MS Leland & Gifford, H.S., 4 speed A.C. m.d. to spindle
1 spindle No. 2MA6 Avey H.S. Type B, m.d., 7½" overhang, 1943
2 spindle Atlas Bench Type, 1942
2 spindle Allen, belted m.d., 8" overhang
2 spindle No. 2 Avey H.S., belted m.d.
2 spindle No. 2BMA, 1 Avey Production Type, m.d.
2 spindle No. 3MA6 Avey H.S., m.d.
2 spindle No. 2 Leland & Gifford H.S., 8" overhang, m.d.
2 spindle Leland & Gifford H.S. Hydraulic Type, m.d.
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4 spindle No. 1/2 MA8 Avey, m.d., H.S.
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4 spindle No. 2BMA6 Avey H.S., m.d.
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6 spindle Allen H.S., 7" overhang
6 spindle Leland-Gifford, m.d. on each spindle, No. 2 taper
6 spindle No. 1 Avey High Speed, m.d.
6 spindle No. 1/2 Avey MA8 Avey, H.S., m.d.

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No. 410 Barnes Single Spindle Deep Hole, m.d.
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Natco Horizontal Drill, 2 opposed B4F2 Head, 1943
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No. 445 W.F. & John Barnes Independent 2 spindle Deep Hole Drilling & Boring Machine, late Model 2F1 Natco Horizontal Boring & Drilling Machine

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6 spindle W.F. & John Barnes Vertical Drilling Machine, m.d.
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30" x 29' oc LeBlond Hv. Duty G. H. Lathe, late type, 2 carriages, tapers, swings 34½", 16 speeds.
12" Morey Vert. Slotter AC motor drive, 24" rotary table, latest type.
14' x 12' x 30' Betts Double Housing Planer, 50 HP DC motor, 4 heads, box table. ACTUAL PHOTOGRAPH AVAILABLE.
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AND A TAPPER . . .

with capacity from .034" x 120 to 1/4" x 24 . . . and a "reserve of accuracy."

2488

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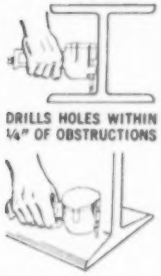

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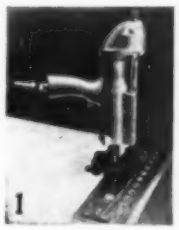

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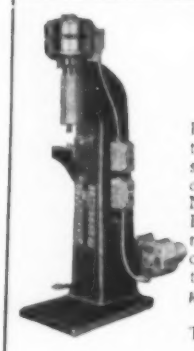

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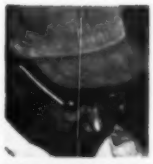

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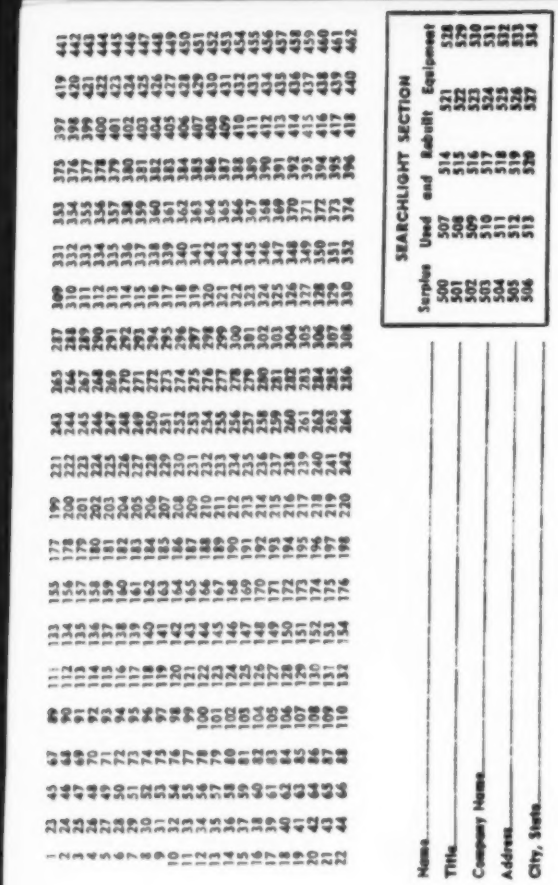

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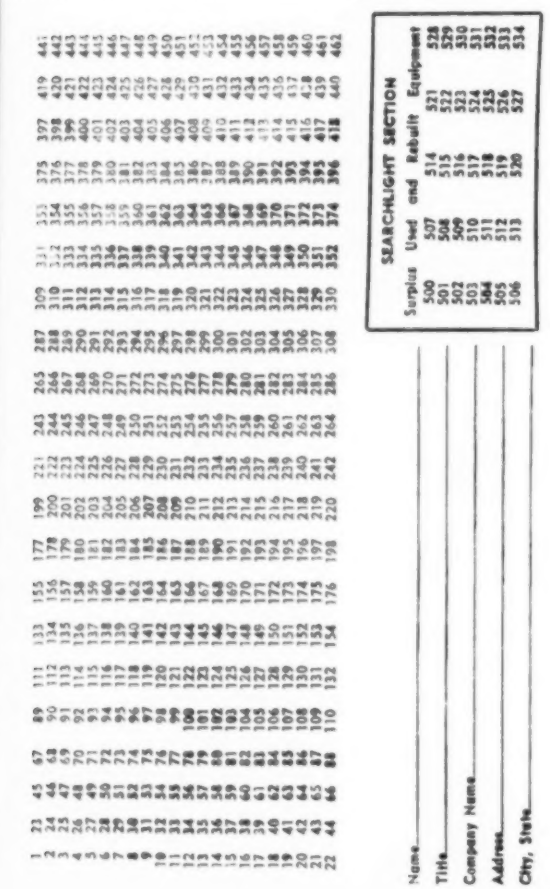

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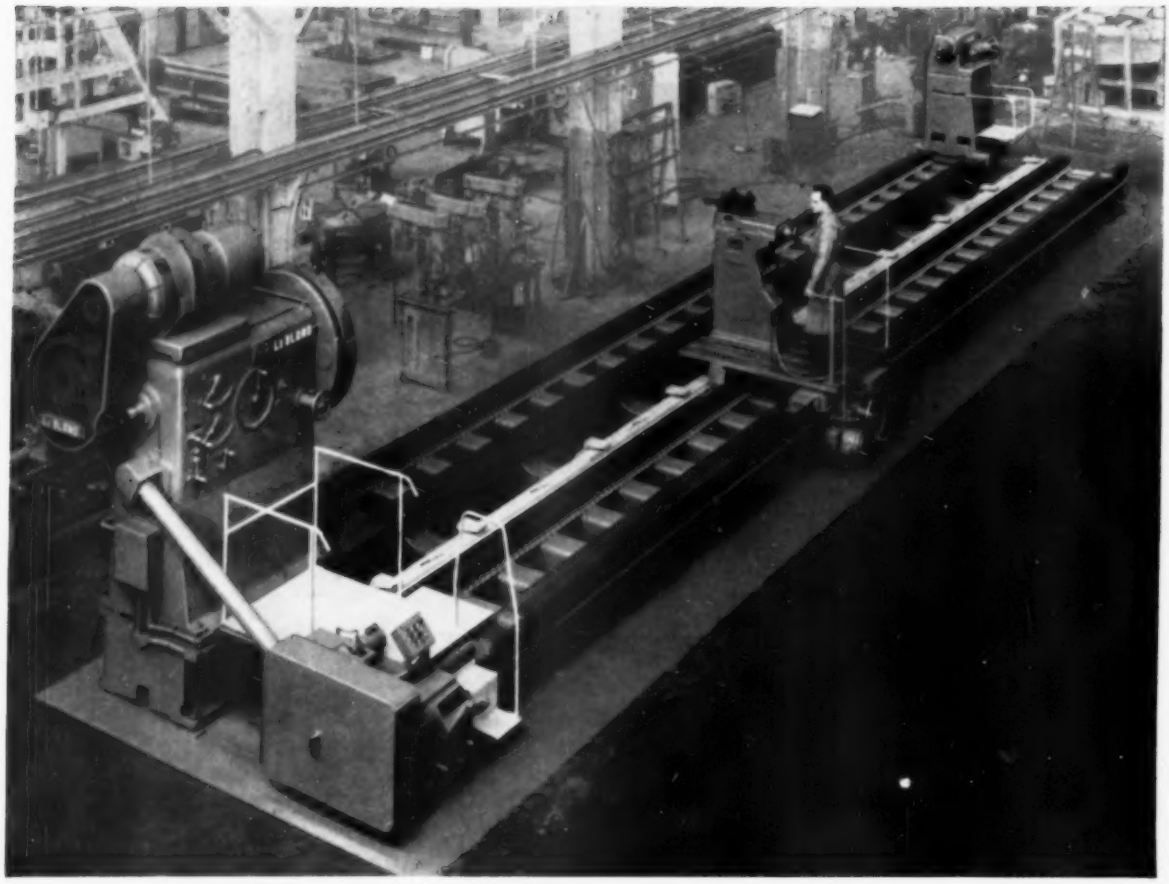

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